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Includes aeronautics (general); aerodynamics; air transportation and safety; aircraft communications and navigation; aircraft design, testing and performance; aircraft instrumentation; aircraft propulsion and power; aircraft stability and control; and research and support facilities (air).

For related information see also *Astronautics*.

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For related information see also *Aeronautics*.

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28 PROPELLANTS AND FUELS 1704
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74 OPTICS 1787
Includes light phenomena.

75 PLASMA PHYSICS 1788
Includes magnetohydrodynamics and plasma fusion.
For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

76 SOLID-STATE PHYSICS 1791
Includes superconductivity.
For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

77 THERMODYNAMICS AND STATISTICAL PHYSICS 1792
Includes quantum mechanics; and Bose and Fermi statistics.
For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

SOCIAL SCIENCES

Includes social sciences (general); administration and management; documentation and information science; economics and cost analysis; law and political science; and urban technology and transportation.

80 SOCIAL SCIENCES (GENERAL) N.A.
Includes educational matters.

81 ADMINISTRATION AND MANAGEMENT 1793
Includes management planning and research.

82 DOCUMENTATION AND INFORMATION SCIENCE 1794
Includes information storage and retrieval technology; micrography; and library science.
For computer documentation see *61 Computer Programming and Software.*

83 ECONOMICS AND COST ANALYSIS 1795
Includes cost effectiveness studies.

84 LAW AND POLITICAL SCIENCE N.A.
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION 1796
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) N.A.

89 ASTRONOMY 1799
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS N.A.
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION N.A.
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS 1800
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION 1800
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL N.A.

Note: N.A. means that no abstracts were assigned to this category for this issue.

SUBJECT INDEX I-1
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CONTRACT NUMBER INDEX I-67
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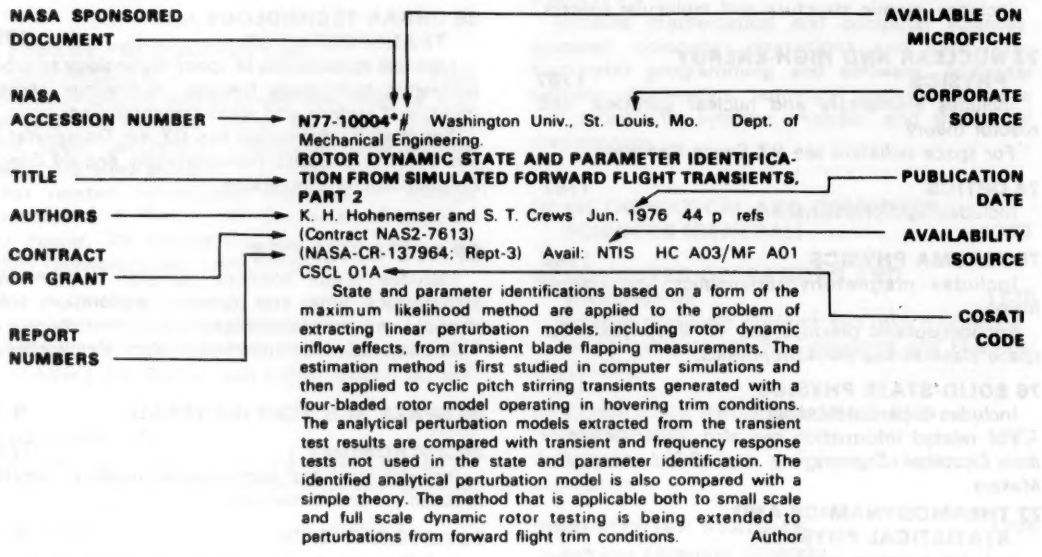
TYPICAL CITATION AND ABSTRACT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N77-10004*# Washington Univ., St. Louis, Mo. Dept. of Mechanical Engineering.
TITLE
ROTOR DYNAMIC STATE AND PARAMETER IDENTIFICATION FROM SIMULATED FORWARD FLIGHT TRANSIENTS, PART 2
PUBLICATION DATE
AUTHORS
K. H. Hohenemser and S. T. Crews Jun. 1976 44 p refs
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(NASA-CR-137964; Rept-3) Avail: NTIS HC A03/MF A01
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COSATI CODE
State and parameter identifications based on a form of the maximum likelihood method are applied to the problem of extracting linear perturbation models, including rotor dynamic inflow effects, from transient blade flapping measurements. The estimation method is first studied in computer simulations and then applied to cyclic pitch stirring transients generated with a four-bladed rotor model operating in hovering trim conditions. The analytical perturbation models extracted from the transient test results are compared with transient and frequency response tests not used in the state and parameter identification. The identified analytical perturbation model is also compared with a simple theory. The method that is applicable both to small scale and full scale dynamic rotor testing is being extended to perturbations from forward flight trim conditions. Author

ON-GOING RESEARCH PROJECTS

This is a listing of research projects - not publications

AERONAUTICS

Includes Aeronautics (general); Aerodynamics; Air Transportation and Safety; Aircraft Communications and Navigation; Aircraft Design, Testing, and Performance; Aircraft Instrumentation; Aircraft Propulsion and Power; Aircraft Stability and Control; and Research and Support Facilities (air). For Related Information See Also Astronautics.

1.0001, HIGH-ALTITUDE SUPERPRESSURED POWERED AEROSTAT (HASPA)
S.H. SCALES, Martin Marietta Corporation, *Denver, Colorado* 80201 (DN585253; N60921-75-C-0150)

Design, fabricate and participate in the test and evaluation of a high-altitude, superpressured aerostat. This work unit summary supports agency accession no. DN485034.

The contract is in five phases - design concept, design, fabrication, unpowered and powered flights, and provides for the design and fabrication of the aerostat hull and hardware, autopilot, onboard instrumentation, and system and flight test support.

ADDENDA: Supporting agency address is: Naval Surface Wpns Cen W.O. Lab Explosions Research Department, Silver Spring, MD 20910

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0002, VHF AVIONICS MODIFICATIONS
UNKNOWN, Bendix Corporation, *Fort Lauderdale, Florida* 33310 (TS58747; TSC-1121)

The joint AEROSAT program will provide a satellite capability: 1. to demonstrate that it will be possible to attain the quality of service expected in an operational phase for air traffic control (ATC) and air carrier purposes; 2. to evaluate the technical and operational performance of voice and data communication between ground and aircraft over various areas; 3. to permit experimental evaluation of dependent and independent surveillance capabilities, and of navigational data derived by an aircraft utilizing ground and satellite transmissions; 4. to contribute data to enable ECAO to develop its Standards and Recommended Practices (SARPS) for an operational capability; 5. to directly compare the performance of VHF and L-band aeronautical satellite systems for voice and data communications and surveillance.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

1.0003, AIRCRAFT ENGINE NACELLE FIRE TEST SIMULATOR
UNKNOWN, U.S. Air Force, Aero Propulsion Lab., *Dayton, Ohio* 45433 (FA59103; FA75WAI-626)

High-performance aircraft with their advanced propulsion systems and extended flight environmental conditions will require delineation of effective fire prevention and control measures. Full-scale engine nacelle installations will not be available for the determination of fire protection criteria and evaluation of fire protection equipment performance. Consequently, a means for simulating anticipated conditions and the evaluations of advanced fire protection measures is necessary. The objective of this program is to provide an aircraft engine nacelle simulator which will allow realistic investigation of engine nacelle fire problems and the evaluation of fire prevention, detection, and extinguishant systems generated by other programs.

SUPPORTED BY U.S. Dept. of Transportation - Off. Sec.

1.0004, METHODOLOGY FOR SURVIVABILITY IN PRELIMINARY DESIGN
D.M. REEDY, Ling Temco Vought Incorporated, *Dallas, Texas* (DF137090; F33615-76-C-3092)

The objective of this effort is to develop a methodology which can rapidly assess, integrate, and optimize survivability, consistent with available detail, in the preliminary design phases of prototype aircraft. Presently, there is no known quantitative methodology which can determine optimum survivability within the desired constraint of an optimally designed aircraft. Development of the methodology will allow aircraft to be designed such that many factors, including total life cycle costs, are optimized. The major benefit will be in the elimination of non-optimal aircraft retrofits which plague the current state-of-the- art.

Four requirements are to be met in attaining the methodology. The first is to survey, assess, and document existing methodological state- of-the-art in order to provide a baseline for this effort. Second, an examination of the baseline for applicability to the preliminary design (PD) process will be conducted. Based on these results, a methodology will be developed to satisfy the objective. Lastly, the developed methodology will be demonstrated in an actual PD, with recommendations for improvement in the methodology.

ADDENDA: Supporting agency address is: AF Flight Dynamics Laboratory FES, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

1.0005, PREDICTIVE ANALYSIS OF CIRCULATION-CONTROLLED AIRFOILS
F.A. DVORAK, Flow Research Incorporated, *Kent, Washington* 98031 (DN581537; N62269-74-C-0316)

To develop a theoretical method for predicting the two-dimensional aerodynamic characteristics of thick, quasi-elliptical, circulation- controlled airfoils. The contract supports work unit NN701, agency accession no. DN481077.

A viscous/potential flow interaction analysis will be performed utilizing several existing and other newly generated automatically computed flow analysis routines. Finite difference and integral boundary layer analyses will be coupled to an accurate potential flow method. The output will consist of Reynolds number dependent pressure and boundary layer distributions and lift, drag and pitching moment coefficients.

ADDENDA: Supporting agency address is: Naval Air Development Center Air Vehical Technology Dept., Warminster, PA

SUPPORTED BY U.S. Dept. of Defense - Navy

1.0006, PERFORM A BATTLE DAMAGE TOLERANT WING EVALUATION.
UNKNOWN, Boeing Company, *Seattle, Washington* 98108 (DN590028; N00019-75-C-0178)

The objective is to establish the technology base necessary for the achievement of damage tolerance in aircraft wing structures at no weight penalty and minimum cost.

The approach to be used is that of employing advanced technology design concepts and material usage envisioned for the next generation of aircraft for the ballistic threat also envisioned for that time period. This work is to involve the experimental verification of the advanced technology design concepts and materials usage.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C., 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

ASTRONAUTICS

Includes Astronautics (general); Astrodynamics; Ground Support Systems and Facilities (space); Launch Vehicles and Space Vehicles; Space Transportation; Spacecraft Communications; Command and Tracking; Spacecraft Design, Testing, and Performance; Spacecraft Instrumentation; and Spacecraft Propulsion and Power. For Related Information See Also Aeronautics.

2.0001, PLASMA INTERACTION EXPERIMENTS AT SYNCHRONOUS ALTITUDE

J.B. REAGAN, Lockheed Missiles & Space Co., *Palo Alto, California* 94304 (DN675180; N00014-76-C-0444)

The objective is to examine spacecraft charging effects at synchronous altitude. Spacecraft charging is a probable cause of failure of electronic circuits and could affect naval satellite communications systems at ultrahigh frequency. A space measurement program will be carried out to specify design criteria and test procedures, which can be used to assure that satellites will not be adversely affected when exposed to electrical charging by the space environment.

The following experiments will be designed and tested for flight on the Air Force Scatha spacecraft, launch date April, 1978: (a) a particle spectrometer to measure electrons of 300-2100 KeV, protons of 1-100 MeV, and alpha particles of 6-60 MeV; (b) a spectrometer to measure the ion composition in the range of 0.1-20 KeV; and (c) a spectrometer to measure the ion composition in the range of 1-100 eV. Data from these instruments will be used to define the properties of the ambient plasma and particle flux prior to and during periods of satellite charging and will allow for interpretation of the charging phenomena observed.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

2.0002, DESIGN OF SOUNDING ROCKET PAYLOADS

M.J. DAVIN, Wentworth Institute, Undergraduate School, *Boston, Massachusetts* 02115 (DF247640; F19628-76-C-0211)

AF function - reconnaissance, surveillance, communication and advanced weapon systems. Deficiency or opportunity - inability to forecast atmospheric interactions affecting the design and operation of military systems such as reentry vehicles, over-the-horizon radar and satellite operations. Objective - to increase ability to forecast atmospheric and spatial variables requires measurements by sounding rocket and satellite payloads. How research contributes - provides payloads for the conduct of experiments measuring those aerospace parameters of importance to AF systems operations. Research, development, and test of components and assemblies are undertaken to create reliable operating payloads for rocket and satellite probes. This work supports such projects as 6690, 7670 and 6688.

ADDENDA: Supporting agency address is: AF Geophysics Laboratory LC L.G. Hanscom AFB, Bedford, Mass. 01730

SUPPORTED BY U.S. Dept. of Defense - Air Force

2.0003, NUCLEAR POWERED SATELLITE STUDIES

M.H. KAPLAN, Penn. State University, School of Engineering, *University Park, Pennsylvania* 16802 (E(11-1)-4045)

A 15-month study of nuclear powered satellite design and mission problems is proposed to assist the Nuclear Research and Applications Division of ERDA in developing new associated technologies. The transition period of the later 70's from expendable launchers to reusable shuttles and from single satellite designs to standardized and modularized configurations represents a unique opportunity to actively campaign for nuclear powered satellites. Many missions could reap a maximum benefit by incorporating such power supplies. The proposed project will deal with the 0.1-100kWe power range and consist of a many-faceted effort. Spacecraft design problems associated with integration of nuclear power will be addressed. Launch constraints and interfaces with respect to the space shuttle and peculiar to nuclear powered vehicles are to be considered. Design of power generators from an overall-mission point of view will be attempted to optimize at the systems level. Finally, missions appropriate for nuclear power will be sought and comparisons made to show competitiveness. The Penn State team will also act in support of NRA needs with respect to specific technology requests on a continuing basis throughout the project life.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - N.R.A.D.

CHEMISTRY AND MATERIALS

Includes Chemistry and Materials (general); Composite Materials; Inorganic and Physical Chemistry; Metallic Materials; Nonmetallic Materials; and Propellants and Fuels.

3.0001, NAVY VEHICLE DESIGN AND CONSTRUCTION - HIGH-TEMPERATURE, HIGH-STIFFNESS PARTICULATE COMPOSITE MATERIALS

O.D. SHERBY, Stanford University, School of Engineering, *Palo Alto, California* 94305 (DN723740; N00014-75-C-0662)

This research is aimed at composite materials with improved high- temperature strength and stiffness for use in jet engines and airframes. Under investigation are the effects of processing variables on the structure and mechanical properties of particulate composites.

Combinations of attrition, hot pressing, and heat treatment will be used to produce particulate composites in the Mg-LiB, iron-cast iron, and rare-earth/transition-metal systems. Mechanical properties will be examined for various processing conditions. The magnetostriction and magnetocoupling coefficient will be determined for the rare- earth/transition-metal combination.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0002, MATERIALS SUPPORT TECHNOLOGY - LIQUID DROP IMPACT DAMAGE FOR CERAMIC MATERIALS

W.F. ADLER, Effects Technology Inc., *Santa Barbara, California* 93105 (DN675494; N00014-76-C-0744)

The erosion of infrared sensor windows, infrared laser windows, and radomes exposed to rain, ice crystals and airborne dust and debris is a serious problem for allweather subsonic and supersonic aircraft and missile systems. The objective of this basic research program is to investigate research damage on crystalline inorganic materials for advanced aircraft and missile systems at impact velocities ranging from 100 to over 1,000 feet per second. This will provide rational directions for development of erosion resistant materials via modification of microstructural features.

Calcium fluoride, magnesium oxide, silicon, germanium, and sapphire will be studied to establish erosion mechanisms responsible for initiating damage during earliest stages of erosion processes. Specimens will be exposed to single and overlapping water drop impingement with an air gun. Microscopic characterization will explore single impact events and interactions of multiple impact events. Surface quality, microplasticity, volume flaws, crystallographic defects, grain boundaries, and crystalline orientation will be controlled to determine their influence on erosion damage. Tests will also be conducted on a rotating arm facility to obtain random multiple water droplet impacts. Tests with 1.8 and 0.5 mm drop diameters will be conducted to identify significant differences in fracture behavior and establishment of scaling parameters. Macroscopic and microscopic damage initiation features and mechanisms are to be established. Characteristics to be determined include initiation surface conditions, microstructure, defect structures and mechanical properties. Post rain erosion specimens will be examined by optical techniques. In addition, mechanical strengths of eroded surfaces and spherical identer measurements will be determined.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0003, WEAPONRY - STRESS AND STRAIN MEASUREMENT IN SOLID PROPELLANTS AND OTHER NAVAL STRUCTURES
V.J. PARKS, Catholic University of America, School of Engin. & Arch., *Washington, District of Columbia* 20017 (DN623496; N00014-75-C-0663)

Technical objectives are to continue to develop advanced photoelastic techniques and experimental stress methods for complex naval structures such as ships and aircraft. Emphasis will be on steady- state thermal stress analysis (shrinkage stresses) and composite materials.

Photoelastic techniques will be extended to the analysis of a broader range of stress and strain analyses of composite materials and structures. Three-dimensional photoelastic techniques will be extended to the steady-state thermal analysis of a class of mixed boundary value problems characterized as the 'pressurized floor tile' problem.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0004, CHARACTERIZATION OF THE RESPONSE OF MATERIALS TO RAPID THERMAL AND MECHANICAL SHOCK LOADINGS
C.D. BEACHEM, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN580004)

The objective of this program is to characterize the behavior of naval structural materials under rapid thermal and mechanical shock loadings. This requires a thorough knowledge of the variation in mechanical properties of these materials during and following transient or long-term thermal excursions; the mechanical shock response of materials to high-intensity radiation; and microstructural modifications induced by such environments which lead to the observed behavior. The knowledge and data generated in this program are relevant to several important Navy material problems, such as exposure to intense electromagnetic radiation, and the aerodynamic heating of launch and reentry vehicles.

Electron beam and laser radiation are used to generate rapid thermal and shock loadings of materials. Rapid heating rate, high-temperature testing facilities are employed to explore the behavior materials at elevated temperatures. Thermal, mechanical and microstructural properties of structural alloys and composites are studied.

ADDENDA: Supporting agency address is: Naval Research Laboratory (6000), Washington, D.C. 20375

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0005, USE OF CERAMICS IN AIRCRAFT ENGINE BEARINGS
M.L. TORTI, Norton Company, *Worchester, Massachusetts* 01606 (DN590156; N00019-76-C-0251)

The objective of this procurement is to investigate the utility of ceramics as a means of increasing performance capabilities, service life or environmental resistance of rolling element bearings for use in turbine engines.

The load life relationships of steel on ceramic and ceramic on ceramic will be evaluated in rolling contact fatigue tests. Aircraft quality precision rolling element bearings with ceramic races and rollers will be designed, fabricated and tested. Silicon nitride and/or silicon carbide are the materials of primary interest.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0006, SERVICE EVALUATION OF GRAPHITE COMPOSITES IN CONTACT WITH METALS ON F-4
P. STIEFEL, McDonnell Douglas Corporation, *St. Louis, Missouri* 63166 (DN781219; N62269-76-C-0280)

To obtain environmental data under navy operational usage for (1) verifying the effectiveness of current design and material selection criteria, (2) verify corrosion prevention methods used in graphite/epoxy-metal combinations, (3) determine amount and rate of water absorption and its effect on mechanical properties of graphite/epoxy composites on naval aircraft. This contract is in support of work unit QA101, 'Aircraft Technology', agency accession no. DN 681080.

Four sets of doors (1 vertical and 1 horizontal per set) will be fabricated with test specimens attached, including graphite laminates, simulated mechanical fastened joints, adhesive bonded joints, and sandwich elements. The doors will be installed on 4 carrier based F-4 aircrafts (one set each) and during an exposure period of 2 yrs., the test doors will be inspected and test specimens removed periodically for moisture absorption analysis. At the end of 2 yrs. exposure the doors will be returned to NavAirDevCen for further non-destructive and destructive test evaluation.

ADDENDA: Supporting agency address is: NADC Air Vehicle Technology Dept., Warminster, PA

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0007, WEAPONRY - PROCESSES AFFECTING COMBUSTION OF SOLID PROPELLANTS
M. SUMMERFIELD, Princeton University, School of Engin. & Appl. Sci., *Princeton, New Jersey* 08540 (DN623049; N00014-75-C-0705)

The Navy missile arsenal contains a wide variety of solid propellant rockets, and it is the objective of this task to advance the understanding of performance behavior of solid propellants, and thereby lay the scientific groundwork for solid propellant rocket developments of the future. The main emphasis here is on solid propellant combustion embracing the description and incorporation into theoretical scheme of all processes, physical and chemical, which occur during the burning of a solid propellant. The fundamental studies of this task form the basis for selection of propellant ingredients and physical design of the solid propellant grain which may be used in Navy ordinance rockets, as well as in solid propellant rockets for any application.

The pressure dependence of the burning rate of DRX and RDX composite propellants will be studied emphasizing the kinetics of RDX decomposition and the rates of reaction of the decomposition products. Differential scanning colorimetry will be used to probe the nature of the RDX melt layer. Low-pressure pyrolysis studies of RDX will be made to better specify the rate and product distribution of RDX decomposition. These rate data will be used in models of the burning process that include reaction, momentum, energy, and mass transfer rates.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0008, PLASTIC FLOW AND FRACTURE CHARACTERISTICS OF HIGH-STRENGTH ALUMINUM ALLOYS
C. CARMAN, U.S. Army, Pitman Dunn Research Labs., *Philadelphia, Pennsylvania* 19137 (DA0B0455)

To characterize the plastic flow, fatigue, and fracture resistance of new high-strength aluminum alloys under static and dynamic loading conditions. This supports pacing materials problems of lightweight materials for munitions, aircraft and missiles.

Fracture toughness and fatigue crack propagation are being determined using linear elastic fracture mechanics. In regard to fatigue characterization, emphasis will be placed on crack initiation and the threshold value of delta k.

ADDENDA: Supporting agency address is: ARCOM Pitman-Dunn Laboratory, Frankford Arsenal, Philadelphia, PA 19137

SUPPORTED BY U.S. Dept. of Defense - Army

3.0009, STUDY OF BERYLLIUM/TITANIUM COMPOSITES
J.P. DENNY, Kawecki Berylco Indus. Inc., *Reading, Pennsylvania* 19603 (DN590163; N00019-76-C-0355)

Conduct a study of beryllium/titanium composites to obtain optimum mechanical properties including minimum 40 ksi proportional limit.

Explore effects of extrusion ratios, temperatures and physical condition of constituents.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

3.0010, OPTIMIZATION OF PROCESSING VARIABLES WHICH AFFECT ADHESION OF ORGANIC COATINGS
A.E. FEATHERSTON, L T V Aerospace Corporation, *Dallas, Texas* 75222 (DN590147; N00019-76-C-0358)

To optimize the processing variables and the tolerances thereon associated with the preparation of metal and composite surfaces for paint application and determine the relationship between theory and the properties of the subsequently applied organic coating, particularly as related to coating adhesion.

Variations in surface preparation will be studied by preparing specimens utilizing commonly encountered processing conditions such as anodizing, followed by the standard aircraft finish system. Quantitative adhesion measurements will be made after the finish system has cured, to determine the acceptable spread of controllable conditions to achieve optimum properties of the finish system.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

ENGINEERING

Includes Engineering (general); Communications; Electronics and Electrical Engineering; Fluid Mechanics and Heat Transfer; Instrumentation and Photography; Lasers and Masers; Mechanical Engineering; Quality Assurance and Reliability; and Structural Mechanics. For Related Information See Also Physics.

4.0001, VISUALLY ACTIVATED SWITCH SYSTEM (VASS)
M. MARCUS, United Technologies Corp., *Norwalk, Connecticut* (DF320110; F33615-76-C-0514)

Design, develop, and fabricate an operational prototype visually activated switch system (VASS) which can be used to evaluate the VASS switching concept in either a laboratory or cockpit-simulated environment. The system shall provide the operator with the capability of remotely activating system control switches by means of head pointing.

Effect switch closures by directing a head-mounted infrared light source onto designated panel- mounted light-sensitive switches. The system shall incorporate and be aligned with a head-mounted reticle generator assembly by which to aim the infrared beam. Switches shall be activated when infrared light is received coincident with a signal from a momentary hand-held trigger switch.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0002, CONTROL THEORY AND APPLICATIONS
R.K. SHARMA, German Avn. & Space Res. Inst., *Porz, Federal Republic of Germany* (DF289370; AF-AFOSR-2846-75)

AF function - research and applications in control theory. Deficiency - much progress has been made in theoretical control and guidance studies, but less progress has been made on the application of these results to the real environment where complications arise due to non-linearities, noise, complexity, constraints, and uncertainties. Research - this research and development work is part of a continuing effort conducted at the institute for the dynamics of flight systems, which aims as specific aspects of the design of flight control systems such as multivariable systems, minimal realization of systems, observability and the development of algorithms to design parameter-in sensitive closed loop systems. How research contributes - this grant will facilitate direct ties with German control scientists who are knowledgeable of all similar work in Europe, and Russia as well, and share their knowledge during their frequent visits to our laboratories and by means of their publications.

A general study of the application of modern control theory to real world systems will be undertaken. Problems encountered in modern aircraft such as non-linearities, noise, increasing system complexity, control constraints and position uncertainties will be considered in designing advanced control systems. Sources from Europe and Russia as well as the U.S. will be surveyed to insure all up-to-date information is considered.

ADDENDA: Supporting agency address is: European Ofc of Aerospace, Rsch & Dvlpmt NRE, Box 14, FPO New York, N.Y. 09510

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0003, ELECTRICAL CHARACTERIZATION OF LINEAR INTEGRATED CIRCUITS
J. KULPINSKI, General Electric Company, *Pittsfield, Massachusetts* 01201 (DF736480; F30602-76-C-0345)

To characterize specific linear integrated circuits, develop and evaluate electrical test procedures and generate detailed test and burn- in requirements for military specification of these devices for inclusion in MIL-M-38510 slash sheets. Detail slash sheets will be generated/reviewed with the specific devices to be determined by RADC based on highest usage and potentially high usage devices for which a specification requirement exists.

For each device-type slash sheet, the specification/test circuit design shall be evaluated where possible using at least ten devices from three different sources. The devices to be considered under this effort will be selected as requirements arise. Device types will include standard level complexity devices such as those presently in the MIL-M- 38510 linear specification series and will cover voltage regulators, high-frequency amplifiers, phase lock loops, analog gates, etc. Any bidder should have previous experience and be familiar with the military specification system and should also have previous experience in the generation of electrical test requirements for commercial procurement of linear integrated circuits. Due to the nature of this effort, this procurement should be restricted to a user activity to prevent any manufacturer bias. End items will be draft military-specification slash sheets for MIL-M-38510, and a final report to contain the evaluation test results.

ADDENDA: Supporting agency address is: Rome Air Development Center RBR, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0004, OZONE OVERBURDEN
B. SELLERS, Panametrics Incorporated, *Waltham, Massachusetts* 02154 (DN323160; N00014-73-C-0316)

The objective of this research is to test a UV (ultraviolet) spectrophotometer on the NASA Convair 990 to determine flux of UV at aircraft altitude as a measure of the ozone overburden and preliminary to putting similar equipment on commercial 747's. Navy relevance derives from the climatology of the stratospheric ozone to be developed and against which climatic impact of certain naval operations could be measured.

The work will require flight time of about ten days for an engineer with the equipment coast to coast and locally around the east coast. Data is recorded on strip charts and on magnetic tape after it is reduced and analyzed for plots of UV flux and total ozone vs. time.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0005, APPLICATION OF SHAPE DISCRIMINATION/FEAT
M. SCHRODER, Control Data Corporation, *Minneapolis, Minnesota* 55420 (DF712110; F30602-76-C-0272)

The objective of this effort is to reduce the false alarms inherent in the change detection process that are caused by uncontrollable variations in aircraft positioning and by small irregularities in ground processing.

A technique will be utilized which uses information available in the current change detection algorithm. PIXELs which are significantly different from their background and adjacent PIXELs will be examined and statistically evaluated.

ADDENDA: Supporting agency address is: Rome Air Development Center IRR, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0006, MULTIPLEX SYSTEMS FOR 'SMART' TERMINALS
L.W. TIMGREN, Honeywell Incorporated, *Minneapolis, Minnesota* 55413 (DF105990; F33615-76-C-1285)

To fully achieve the benefits of standardization the interface between the data bus remote terminal, the avionics must be analyzed and optimized. The objective of this study is to determine the optimum interface between avionic subsystems and data transfer remote terminals. A secondary consideration is the evolution of standard signal structure and common signal processing from today's data transfer systems.

Representative avionic subsystems will be selected. An external and internal analysis of the origin of these signals will be conducted. Compatibility with revised MIL-STD 1553A will be determined and subsystem hardware changes will be proposed.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0007, OPTICAL WAVEGUIDE COUPLING
W.S. CHANG, Washington University, School of Engin. & Appl. Sci., *St. Louis, Missouri* 63130 (DF900940; F19628-76-C-0032)

AF function - communications technology. Deficiency or opportunity - problems of security, susceptibility to electromagnetic interference and inadequate signal bandwidth. Objective - to develop new light coupling technique effectively between optical fibers and GaAs thin-film waveguides. How research contributes - efficient coupling technology is necessary so that new integrated optics components can be used in optical circuits. Minimizing coupling losses will also allow more sub- stations in optical fiber communications systems.

A tapered transitional waveguide (tapered high-refractive-index film with low-index substrate) will be used to couple into the fiber. This has the advantage that phase matching is achieved automatically by the taper and that no critical mechanical alignment is involved. The difficult task of coupling between the tapered transitional waveguide and the GaAs waveguide (because GaAs has the highest refractive index of all the materials transparent in the near infrared) can be solved via a second taper or by end excitation.

ADDENDA: Supporting agency address is: Rome Air Development Center ETS, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0008, PURIFICATION, CONTROLLED DOPING AND CRYSTAL GROWTH OF II-VI SEMICONDUCTORS
G. WEBB, Eagle Picher Industries Inc., *Miami, Oklahoma* 74354 (DF680730; F33615-73-C-4013)

AF function - electronic devices and components. Deficiency - materials with stable electronic and optical properties. Research - materials purification and crystal growth. How research contributes - provides high-purity material and single crystals for study of electrical and optical properties needed in devices and components.

The contractor will purify the component elements by suitable techniques, then he will react them to produce high-purity semiconductor compounds. He will also study growth of II-VI group of semiconductors by melting them under high pressure and cooling them in a temperature gradient to produce undoped crystals of higher purity, or doped crystals of higher structural quality. He will achieve suitable doping in these crystals by adding soluble salts.

ADDENDA: Supporting agency address is: AF Materials Laboratory LPO, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

4.0009, WIND SENSOR DEVELOPMENT
J. ARAKELIAN, Pharos Incorporated, *Broomall, Pennsylvania* 19008 (DN590045; N00019-75-C-0244)

To develop a lightweight, reliable wind measurement device that employs no moving parts for use on automatic weather stations.

The contractor is developing a no-moving-parts wind sensor of unique design. The wind force is determined by electrically measuring the displacement of fixed plates. The purpose of this contract is to determine the effects of a range of temperature variations on the performance of the sensor. The tests will be conducted in a wind tunnel.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

4.0010, THE NUMERICAL SIMULATION OF TRANSITION IN FLUID DYNAMICS
C.E. GROSCH, Old Dominion University, Graduate School, *Norfolk, Virginia* 23508 (DN575368; N00014-75-C-0777)

An understanding of the nature of transition from laminar to turbulent flow is central to the development of a predictive methodology for use in design and optimization in aerodynamics and hydrodynamics. The proposed research will carry out numerical simulations of instability and transition in laminar boundary layers by solving the navier-stokes equations by finite difference methods.

An accurate prediction of transition from laminar to turbulent flows would represent a major advance in our understanding of such phenomena and in our ability to incorporate such information in naval systems design. Since numerical solutions of the Navier-Stokes equations will be utilized, heuristic assumptions and modeling will be unnecessary. Specifically, the transition of laminar incompressible boundary layers will be studied with particular attention to the effects of: pressure and vorticity fluctuations in the free stream, surface roughness, two- and three-dimensional Tollmien-Schlichting waves, and streamwise pressure gradients.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

GEOSCIENCES

Includes Geosciences (general); Earth Resources; Energy Production and Conversion; Environment Pollution; Geophysics; Meteorology and Climatology; and Oceanography. For Related Information See Also Space Sciences.

5.0001, APPLICATION OF REMOTE SENSING FOR NATURAL RESOURCE ANALYSIS
E.L. SMITH, Univ. of Arizona, Agric. Experiment Station, *Tucson, Arizona* 85721 (0058972; ARZT-2014-4168-026)

OBJECTIVE: Characterize basic land units in southeastern Arizona. Develop criteria for measuring productive potential, condition and trend on these units. Develop criteria for mapping associations of basic units. Gather information on properties and management of units.

APPROACH: Basic land units will be identified on aerial photos and characterized by images pattern and field data. Once defined, the units will be studied under different management histories to evaluate condition and trend criteria. Criteria for mapping associations of land units will be developed using other existing resource maps and imagery. The study will be concentrated in Santa Cruz County.

PROGRESS: Ground truth data from 300 locations on alluvium were analyzed by cluster analysis, regression and association tables. Twenty-three tentative sites were identified based on topographic position, solar insolation received, soil and vegetation characteristics. Photointerpretability was checked with reasonable success. Additional field work is being done to improve data base for some sites and test ability to extrapolate to other areas by photointerpretation. This study will be extended to vegetation types underlain by bedrock.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

5.0002, LIDAR APPLICATIONS
V.E. DERR, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8AA7 15 31)

PROJECT OBJECTIVE: Develop and apply to atmospheric measurements a multiwavelength lidar system with radar, radiometry and solar photometry to measure geometric, statistical and optical properties of clouds and aerosols. Develop remote sensing techniques to identify clouds and aerosols.

CURRENT YEAR PLAN: Study growth processes in clouds and relation to convective boundary layer. Determine optical properties of clouds and aerosols as a function of particle parameters.

PROGRESS REPORT: Statistics of orographic cloud geometry have been obtained. Generation by streamers of glaciation is under investigation in Fraser 1975 data. Preliminary data on optical properties of ice clouds have been obtained.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0003, MAGNETOSPHERIC PHYSICS

D.S. EVANS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8DJ4 04 10)

PROJECT OBJECTIVE: Using the particle data from the S3 satellite, members of this group have unambiguously identified the ion cyclotron resonant interaction as being the dominant process governing the loss of energetic trapped protons from the radiation belts during the discovery phase of a geomagnetic storm.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0004, HURRICANE MODIFICATION STUDIES

LASEUR, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8G121223)

PROJECT OBJECTIVE: 1. Collect quantitative observations of hurricanes utilizing airborne and land-based radars as opportunity permits. 2. Conduct studies of rainfall rates, accumulated amounts and patterns associated with hurricanes as determined from calibrated radars and rain gage stations. 3. Study the life cycle of convective cells of hurricanes as pertains to size, intensity movement and propagation. 4. Study the outflow from hurricanes Bell, Emmy, and Frances as determined from aircraft and satellite measurements.

CURRENT YEAR PLAN: 1. Record data for any hurricane in range of a land-based radar or on any hurricane flights of NOAA 42 and 43 in 1977. 2. Prepare and finish corresponding reports.

PROGRESS REPORT: 1. Quantitative radar data was obtained on hurricanes Caroline, Eloise and Gladys in 1975 and hurricane Belle in 1976. 2. Work currently under way on hurricane Eloise data set. 3. Work begun on hurricane Belle and Eloise data set. 4. Data not processed or available at this date. 5. Report in preparation.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0005, HURRICANE MODIFICATION

R.C. SHEETS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8G121332)

PROJECT OBJECTIVE: To produce the necessary information for use in designing and evaluating hurricane modification experiments - primarily using conventional aircraft and satellite data.

CURRENT YEAR PLAN: Continue development of the variational optimization technique for analysis of experimental and background data. Investigate the seedability of selected portions of hurricanes. Investigate the cloud particle state and supercooled liquid water and ice contents in hurricane clouds. Investigate the boundary layer structure in the high-wind-speed portion of the hurricane. Investigate the effects of the hurricane on the sea surface temperature and thermocline.

PROGRESS REPORT: Determined that the ocean 'remembers' passage of a hurricane where inertial waves were generated and remained prominent for more than 10 days after passage. Determined and documented the cloud particle state in selected clouds in hurricanes Carolina, Eloise, and Gladys. Determined the existence of 'seedable' clouds in the proper areas of hurricanes Eloise and Gladys. Determined that it is operationally feasible to fly down rain bands in the high-icing, super- cooled water region, thus attaining a potentially more efficient seeding pattern.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0006, HURRICANE RESEARCH

R.C. SHEETS, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8C351331)

PROJECT OBJECTIVE: To increase the understanding of the hurricane structure, interactions, and processes ranging from the microscale to the synoptic scale. These studies are aimed at improving the predictability through better parameterizations, data inputs and/or formulations for models or recognizing significant features leading to predictable storm development or structural change.

CURRENT YEAR PLAN: Continue investigations of the boundary layer and air-sea interaction processes in the hurricane environment using aircraft data. Continue investigations of the convective structure of hurricanes using high-resolution satellite data and airborne and land- based radar. Continue investigations of the thermal structure and short-term natural variability of hurricanes. Continue investigations of the micro-physical processes in hurricanes.

PROGRESS REPORT: The micro-physical structure of selected clouds in hurricanes Caroline, Eloise and Gladys was investigated and partially documented. Boundary layer measurements were obtained in the fringe region of the hurricane and turbulence measurements were obtained at several locations within the hurricane. The sea surface and thermocline structure under hurricanes Eloise and Gladys were documented. The large natural variability of hurricanes Eloise and Gladys was partially documented.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0007, PLASMA PHYSICS & TURBULENCE

J. WEINSTOCK, U.S. Dept. of Commerce, Environmental Research Labs., *Boulder, Colorado* 80302 (8DJ4 08 22)

PROJECT OBJECTIVE: Conduct theoretical research on waves and turbulence which occur in the earth's atmosphere and their effect on eddy transport. Such processes include gravity waves, plasma turbulence, mass, charge, energy transport, eddy diffusion and pollution dispersal.

CURRENT YEAR PLAN: Apply theory to determine turbulent diffusion in the troposphere from Sunset Radar data. Use HICAT data and Sunset Radar data to determine turbulent diffusion in the stratosphere. Compare with results of Lilly et al., and Panofsky. Calculate contribution of gravity waves to eddy diffusion in the atmosphere from 20 km to approximately 100 km. Calculate Lagrangian time scale for turbulent diffusion. Continue theoretical work on Noxon's mesospheric airglow observations. Continue work on Homogeneous Turbulence theory.

PROGRESS REPORT: Obtained approximate solution of Lagrangian- Eulerian problem for turbulent diffusion. Verified Corrsin's Hypothesis; and explained computer simulations of Lagrangian dynamics performed by Peskin at NCAR. Completed theory for nonlinear frequency shift of gravity waves. Frequencies are proven to be shifted as much as a factor of 2, and should be observable. Developed a theory of Homogeneous Turbulence. The result may provide a theoretical explanation for the Kolmogoroff 5/3 spectrum law.

Began a comprehensive theory for the gravity wave fluctuations of O2(1 beta) airglow observed by Noxon.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0008, DETERMINATION OF SPATIAL POSITIONS OF PREMARKED POINTS ON THE EARTH'S SURFACE USING A PRECALIBRATED RESEAU AERIAL CAMERA

C. SLAMA, U.S. Dept. of Commerce, Coastal Mapping Division, *Rockville, Maryland* 20852 (83241000)

The precise determination of the spatial positions of premarked points on the Earth's surface using aerial photography and numerical adjustment procedures. This method will be used to densify geodetic triangulation in hard-to-survey urban areas.

The technical objective is to study the feasibility of using a precalibrated reseau aerial camera to determine the spatial positions by methods of analytical triangulation of premarked ground points making use of an optimal combination between lens

characteristics, filter, and reflectance of the point markers. The goal is to develop a method more economical and time responsive than classical geodetic triangulation for determining geodetic points with accuracies and density compatible with engineering requirements.

The program includes the application of a specially designed, high- precision, wide-angle, reseau equipped aerial camera lens cone. Available expertise in the design of square matrix inversion, bandwidth minimization, camera calibration and precision mensuration will be applied to the data reduction and software development phase. Actual tests of the system will be carried out in an area surveyed by classic methods.

Work plan - calibration of camera using star field as well as over a premarked ground test area. Development of optimized analytical data reduction program and other supporting software. Develop software for aerial calibration of camera and perform full-scale test of complete system over an area with adequate geodetically determined test points.

Test exposures of the system were obtained over the premarked Casa Grande, Arizona, test field. An automated data mensuration procedure has been developed and is presently being applied to the test data. Computer preprocessing of the measured data has begun, and preliminary accuracy figures should be available by midyear. Extensive calibration of the camera reseau is near completion along with the results of the precise stellar calibration of the camera lens inner geometry. Reduction computer software and investigations of variations in reduction logic are proceeding according to schedule.

SUPPORTED BY U.S. Dept. of Commerce - N.O.A.A.

5.0009, ATMOSPHERIC INFLUENCES ON ECOSYSTEMS AND SATELLITE SENSING

G.W. PETERSEN, Penn. State University, Agric. Experiment Station, *University Park, Pennsylvania* 16802 (0057486; PEN01887)

OBJECTIVE: Develop methods for evaluation and utilization of remotely sensed data pertaining to agricultural ecosystems for ERTS and aircraft; evaluate environmental effects by use of a chemical reduction temperature integrator and an inter-regional phenological network.

APPROACH: Repetitive satellite imagery will be obtained from areas in Pennsylvania with well-established ground truth and with considerable information presently available. Remotely sensed imagery will then be evaluated as to its capability of detecting this known information and to its potential use in the preparation of geologic, soils, vegetation and land-use maps. Persian lilac will be eased in phenological network and data collected systematically.

PROGRESS: An extensive operational capability was developed for the processing, interpreting, and analyzing of remotely sensed data. A data processing system has been developed that is capable of producing statistical information, performing pattern recognition routines, and generating other types of analyses of remotely sensed data. Character maps are produced by each component of the system. Line maps corresponding to any character map can be produced to a given scale without scanner or character map distortion. Photointerpretive techniques and automatic computer processing methods have been developed and used, separately and in a combined approach. Landsat, Skylab and aircraft data have been used for land cover mapping, gypsy moth defoliation studies, delineation of floodplains, detection of vegetative damage and altercation caused by pollutants, regional geologic mapping, and for classification and mapping of coal refuse, vegetative cover types and forest types. A network of Persian lilac plants was established at 29 sites throughout the Commonwealth of Pennsylvania. Most of these sites have been reporting date of first leaf and date of first flower for a three-year period.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

5.0010, STUDY OF TRIGGERED ELECTRON PRECIPITATION FROM AN EXPLOSIVE DETONATION IN THE IONOSPHERE

W.R. SHELDON, Univ. of Houston, School of Arts & Sciences, *Houston, Texas* 77004 (ATM76-82653)

Ionospheric-magnetospheric coupling will be investigated by the Trigger sounding rocket campaign to be conducted at Kiruna, Sweden, in January 1977. The University of Houston Space Physics group will participate in this campaign to measure the flux of bremsstrahlung X- rays following an explosive detonation in the ionosphere. The Houston X-ray detectors will be boosted to high altitude aboard a Super Arcas rocket and descend by parachute. Two flights will be made, one during each of the two release experiments of the Trigger campaign.

The major objective of this campaign is to further our understanding of wave-particle interactions in the magnetosphere-ionosphere. This is important due to the more general application to the problem of particle precipitation.

SUPPORTED BY U.S. Natl. Science Foundation

5.0011, STUDY OF STIMULATED ELECTRON PRECIPITATION DATA FROM ROBERVAL, CANADA

W.R. SHELDON, Univ. of Houston, School of Arts & Sciences, *Houston, Texas* 77004 (DPP76-24402)

The objective of this research is to obtain a better understanding of the earth's magnetosphere through the analysis of a large body of data on very-low-frequency waves and high-altitude X-rays collected during summer balloon campaigns in 1973 and 1975 in Roberval, Quebec, Canada.

SUPPORTED BY U.S. Natl. Science Foundation

5.0012, ATMOSPHERIC INFLUENCES ON ECOSYSTEMS AND SATELLITE SENSING

R. LEE, West Va. University, Agric. & Forestry Expt. Sta., *Morgantown, West Virginia* 26506 (0057138; WVA00223)

OBJECTIVE: Evaluate environmental efforts by use of a chemical reaction temperature integrator and an interregional phenological network. Develop improved statistical relationships and analyses of solar radiation and certain other atmospheric variables of fundamental impact on plant growth and yield.

APPROACH: Environmental effects will be evaluated by use of a chemical reaction temperature integrator and an interregional phenological network. Appropriate statistical methods will be programmed for processing and summarization of climatological data. Data from a previous regional project will be used and additional data will be acquired from the National Weather Records Center, ESSA. Research will focus on variables with direct and important effects on crops, e.g., solar radiation, degree days and drought.

PROGRESS: Phenological observations on the established network of Persian lilac, 'Red Rothomagensis,' were obtained for the growing season 1975. The West Virginia data were summarized and combined with similar data for northeastern United States; regional analyses are being conducted at Cornell University. Research on the use of chemical temperature integration in a phenological network has demonstrated the feasibility of correlating phenological events with sucrose inversion.

SUPPORTED BY U.S. Dept. of Agriculture - C.S.R.S.

LIFE SCIENCES

Includes Life Sciences (general); Aerospace Medicine; Behavioral Sciences; Man/system Technology and Life Support; and Planetary Biology.

6.0001, PERFORMANCE MEASUREMENT/THEORETICAL AND PRACTICAL ISSUES

D. VREULS, Canyon Research Group Inc., *Thousands Oaks, California* 91361 (DN594017; N61339-75-C-0091)

Fundamental to control of the training process is the use of appropriately selected measures of performance. Heretofore, certain key statistical, theoretical and practical issues underlying measure selection have not been realistically addressed for application to aircrew training. This task will determine impact of these issues on automated performance measurement systems.

A recently developed data base describing pilot performance of instrument flight maneuvers will be subjected to additional analyses to determine (1) selection study sample size requirements, (2) performance prediction methods and criteria, (3)

measurement clusters which define skill changes that occur during training, and (4) a mapping of performance dimension changes into meaningful scales of goodness.

ADDENDA: Supporting agency address is: Naval Training Equipment Center, Human Factors Lab, Orlando, FL 32813

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0002, APPLICATION OF VOICE TECHNOLOGY IN AUTOMATED SYSTEMS

I. GOLDSTEIN, U.S. Navy, Human Factors Laboratory, *Orlando, Florida* 32813 (DN494002)

Develop techniques for improving quality control while reducing costs of training Navy personnel to perform control activity such as ground-controlled approach (GCA), other surface-based controller tasks and certain mission control functions of naval flight officers. These jobs have in common the use of restricted, stylized speech to guide a man-machine system. This project will examine the training value of systems which incorporate advanced technologies such as: (a) machine understanding of spoken commands; (b) automated adaptive instruction; (c) advanced computer programming structures; (d) advanced training requirements analysis.

Study the conceptual and technical feasibility by developing a laboratory version of a system for training students in the precision approach radar (PAR) phase of GCA. If first stage is successful, extend concept to other phases of GCA and to other controller-type training situations. When appropriate, conduct validation studies in an operational training setting.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Human Factors Lab, Washington, D.C. 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0003, SYSTEMS APPROACH TO TRAINING (A-6E)

M. MORGANLANDER, Grumman Corporation, *Great River, New York* 11739 (DN594013; N61339-75-C-0099)

Develop procedures/models which will permit the deliberate and orderly planning of specific aircraft instructional programs necessary to ensure that personnel acquire the knowledge, skills, attitudes and behaviors essential for successful job performance in a specified aircraft. The models will include selection of the appropriate analyses necessary for performance parameter development and specification of training/behavioral objectives and will provide a basis for the selection of instructional material, methods, media, and equipment necessary for the development of an optimal, cost-effective curriculum.

Existing SAT methodology will be used to produce lesson specifications, media selection and analysis for each of the weapon systems. The program efforts will be limited to operator and tactical positions of the EA6B, E2C, A6E weapons systems.

ADDENDA: Supporting agency address is: Naval Training Equipment Center, Human Factors Laboratory, Orlando, FL 32813

SUPPORTED BY U.S. Dept. of Defense - Navy

6.0004, DEVELOPMENT OF HUMAN OPERATOR MODELING TECHNIQUES FOR COMPUTER SIMULATION OF AF SYSTEMS

R.G. MILLS, U.S. Air Force, Aerospace Medical Res. Lab., *Dayton, Ohio* 45433 (DF319200)

The objective of this effort is to develop techniques for modeling the human operator and applying the models to computer simulation of complex systems. The techniques developed will be in the form of a set of guidelines, principles, and/or hypotheses developed through long- range, systematic, and comprehensive research. The techniques developed will be the product of this effort and will allow the user (systems design engineer, operations research analyst, human engineer, etc.) to make appropriate model inputs to computer simulation of complex systems.

A complete simulation program has been developed for a remotely piloted vehicle (RPV) system simulation presently being employed in AMRL's RPV System Simulation Program (7184-13-01, 7184-14-02). The RPV system simulation requires live operators while the complete simulation simulates operator performance as well as remaining system elements. The complete simulation will (a) allow the input and execution of alternative human operator models, (b) compare expected system performance, as predicted by exercising the complete simulation program, with empirical system performance (obtained under 7184-14-02), and (c) evaluate the influence of alternative human operator models and assumptions on simulated system performance. This effort was formerly documented as 7184-09-11, Human Performance Dynamics and Reliability for Air Force Systems.

ADDENDA: Supporting agency address is: 6570 Aerospace Medical Rsch Lab HE, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

6.0005, AMST TOXIC GAS ASSESSMENT

R.C. LIGDAY, U.S. Air Force, School of Aerospace Med., *San Antonio, Texas* 78235 (DF320380)

This effort will determine chemical composition of the cabin breathing environment in the advanced medium short-takeoff-and-landing transport (AMST) during simulated open-door flight operating modes. This support was requested by the AFFTC Human Factors Group to quantitate engine backwash into the flight deck and cargo compartment in the in- flight flap-down configuration.

Flight testing will be done at Edwards AFB on both the YC-15 and YC-14 aircraft. Continuous measurements will be made of the cabin concentration of carbon monoxide, oxides of nitrogen and exhaust hydrocarbons during open-door flight maneuvers.

ADDENDA: Supporting agency address is: USAF School of Aerospace Medicine VN, Brooks AFB, Texas 78235

SUPPORTED BY U.S. Dept. of Defense - Air Force

MATHEMATICAL AND COMPUTER SCIENCES

Includes Mathematical and Computer Sciences (general); Computer Operations and Hardware; Computer Programming and Software; Computer Systems; Cybernetics; Numerical Analysis; Statistics and Probability; Systems Analysis; and Theoretical Mathematics.

7.0001, DEVELOPMENT OF LOW-LEVEL ATMOSPHERIC TURBULENCE MODEL

W.S. LEWELLEN, Aeronautical Res. Associates, *Princeton, New Jersey* 08540 (DN590008; N00019-75-C-0154)

Develop a computer model that will take the output from existing operational atmospheric models and predict detailed distributions of wind, temperature, and humidity as well as turbulence and turbulent transport in the lower layers of the atmosphere at selected locations and times over the ocean.

An invariant second-order closure model of turbulent nuclear flow and mass transport has been developed. This model must be generalized (1) by including humidity as a variable and (2) by appropriate coupling to the sea state. Humidity will be treated as a trace constituent which is conserved as it is convected and deferred except for the possibility of condensation (or evaporation).

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20360

SUPPORTED BY U.S. Dept. of Defense - Navy

7.0002, NAVIER-STOKES NUMERICAL METHODS FOR CALCULATING HIGH REYNOLDS NUMBER SEPARATED FLOWS

P.J. ROACHE, Ecodynamics Res. Assoc. Inc., *Albuquerque, New Mexico* 87108 (DN575061; N00014-76-C-0636)

The effectiveness of aircraft, whether conventional or V/STOL, at low speeds is reduced by flow separation. The separation is caused by adverse pressure gradients induced by, for example, deflected control surfaces, high incidence angles of the wings, or deflected jets. This research is a numerical approach, within the framework of the Navier- Stokes equations, for the develop-

ment of a methodology to calculate low- speed separated flows with particular emphasis on high Reynolds numbers.

Flow separation at low speeds is an extremely complex phenomenon which can, at this time, be described in general only by detailed and tedious experiments or possibly by numerical calculations for an extremely limited set of special cases. Separation is beyond the scope of conventional boundary layer theory, and hence predictive procedures must rely on phenomenological modeling, higher order approximations, or numerical solutions of the Navier-Stokes equations. For high-Reynolds- number separated flows, special techniques must be developed for solving the Navier-Stokes equations such that the truncation errors in the convective terms do not swamp the complete viscous terms. This research will study the application of spectral methods to such problems, paying attention to the development of techniques for handling non-periodic data domains in periodic fashion with a finite number of continuous space derivatives at the boundaries. The periodic treatment is important from the viewpoint of developing a general methodology for broad classes of flow problems.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

7.0003, NUMERICAL PROBABILITY, QUEUEING THEORY AND SEARCH

E.M. KLIMKO, State University of New York, Graduate School, *Binghamton, New York* 13901 (DF040750; AF-AFOSR-2813-75)

Ground support of aerospace systems becomes increasingly complex as the systems themselves increase in complexity. Again, the increasing cost of maintaining and servicing aerospace systems necessitates the development of improved methods for the deployment of such support systems. The central goal of this research program is the development of methods of applied probability theory, in particular, methods of queueing theory, which accurately model support systems and are amenable to efficient computational algorithms for the numerical investigation of stochastic models. One specific model to be considered relates to the servicing of aircraft by supply and fuel facilities. The research program incorporates sophisticated computer techniques for implementing the algorithms necessary to obtain the probability distribution of the total operational time and the waiting time for each customer at each station. Minimizing the computation time and the memory storage requirements is one objective, along with a high degree of numerical accuracy. Such problems are examined in the context of numerical probability, the numerical evaluation of convolution polynomials, lumping procedures for discrete convolutions, and probability bounds with high order moments. Related questions of stochastic processes, search problems and integer programming are also considered.

ADDENDA: Supporting agency address is: AF Office of Scientific Research NM, Bldg. 410, Bolling AFB, D.C. 20332

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0004, S/W DATA ACQUISITION

R. TURNER, Boeing Company, *Seattle, Washington* 98108 (DF728410; F30602-76-C-0152)

The objective of this effort is to establish an error data base to support in-house research in software reliability modeling techniques.

Software error data detailing the complete error history of a large Defense Department systems development project will be purchased. This error data will be used to aid in the analysis of software reliability techniques. This software data will also aid in the development of techniques for software data collection through analysis of existing error data reports and will become part of a software data repository (reference contract F30602-75-C-0257).

ADDENDA: Supporting agency address is: Rome Air Development Center ISI, Griffiss AFB, N.Y. 13440

SUPPORTED BY U.S. Dept. of Defense - Air Force

7.0005, NUMERICAL METHODS FOR COMPUTER SOLUTION OF ENGINEERING PROBLEMS

S.J. PARTER, Univ. of Wisconsin, School of Natural Sciences, *Madison, Wisconsin* 53706 (DN823218; N00014-76-C-0341)

Improvements in the design of both ships and aircraft and a better understanding of the Navy environment depend on more accurate and more rapidly obtainable numerical solutions to differential equations used for description, prediction, and control of physical phenomena. Such phenomena include fluid and gas dynamics, certain chemical reactions, and electrodynamic phenomena. The objective of this task is to develop accurate and efficient methods for the computer solution of differential equations which recur continually throughout engineering applications, with particular emphasis on fluid mechanics.

Both analytical results and numerical methods will be derived for two point boundary value problems (and singular perturbations thereof), nonlinear elliptic equations, free boundary value problems, and functional ordinary differential equations. Such problems often exhibit very delicate, and even pathological, behavior. Thus, an analytic understanding of the problems is often a necessary prelude to the development of successful numerical techniques.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

PHYSICS

Includes Physics (general); Acoustics; Atomic and Molecular Physics; Nuclear and High-energy Physics; Optics; Plasma Physics; Solid-state Physics; Thermodynamics and Statistical Physics. For Related Information See Also Engineering.

8.0001, SOLID-STATE PHYSICS

M.L. COHEN, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (DMR76-20647)

Research previously supported under DMR72-03206 will be continued. A broad program in theoretical solid-state physics and material research in the fields of semiconductors (electrical and optical properties), superconductors, magnetic materials, surfaces, electron hole drops, amorphous solids and interactions of monopoles with crystals will be undertaken. The empirical pseudopotential method will be used in the calculation of the electronic properties of semiconductors and superconductors.

SUPPORTED BY U.S. Natl. Science Foundation

8.0002, LOW-TEMPERATURE RESEARCH IN LIQUID HELIUM

R.E. PACKARD, Univ. of California, School of Letters & Science, *Berkeley, California* 94720 (DMR76-82934)

Research done under this grant will be a continuation of research begun under NSF Grant No. DMR73-02461. The work involves two main projects: vortex photography and ultralow-temperature research on 3He. A technique has been developed to photographically record the positions of quantized vortex lines in superfluid helium. Both the dynamics of vortex motion and the equilibrium distribution will be studied. The 3He work is done in a nuclear demagnetization refrigerator. Experiments to study the flow properties and magnetic relaxation properties of the low-temperature phases of 3He will be performed.

SUPPORTED BY U.S. Natl. Science Foundation

8.0003, MICROSCOPIC STUDY OF LOW-LYING EXCITATIONS IN SUPERFLUID HELIUM-THREE AND SUPERCONDUCTORS

K. MAKI, Univ. of Southern California, School of Letters Arts & Sci., *Los Angeles, California* 90007 (DMR76-21032)

This is a continuation and extension of research started under NSF grant DMR74-23429. The basic thrust is to study the theory of dynamical properties of superfluid 3He and superconductors from a completely microscopic point of view. Specific problems under study are: 1.) Nonlinear Dynamics of Superfluid 3He - The basic equation governing the spin motion in superfluid 3He-A and B in the absence of dissipation have been derived. Ex-

plicit solutions of physical relevance remain to be found. 2.) Dissipation Phenomena in Superfluid 3He - A formulation of the transport coefficients in superfluid 3He-B has been developed. Of further interest is the effect of dissipative terms on the nonlinear spin-orbital dynamics of superfluid 3He. 3.) Surface Phenomena in Superfluid 3He - The magnetic coupling as well as the acoustic coupling between liquid 3He and magnetic or nonmagnetic substance will be studied. 4.) Low-Lying Excitations in Superconductors - Of particular interest are the fluctuation of the order parameter in the clean type II superconductor, and that in the type I superconductor far below the transition temperature. 5.) Dynamics of Superconductors with Periodic Substructures - The interaction between the periodic substructure and the vortex lattice will be examined and the effect of periodicity on the basic superconducting properties will be studied.

SUPPORTED BY U.S. Natl. Science Foundation

8.0004, COMMUNICATIONS - CONDENSATION OF INJECTED ELECTRONS AND HOLES IN SEMICONDUCTORS
T.C. MCGILL, Calif. Inst. of Technology, Graduate School, *Pasadena, California* 91109 (DN475263; N00014-75-C-0423)

The Navy has need for improved solid-state devices in electronic communication and control systems. This research will approach problems that arise when devices are cooled to low temperatures, and will investigate the light emission that arises from interactions of injected electrons and holes in devices.

A comprehensive experimental program will study the condensation of the electron-hole gas injected in semiconductor double injection devices at low temperatures. Emphasis will be placed on studying the electrical device double-injection process at low temperatures and its interaction with condensate will be developed.

ADDENDA: Supporting agency address is: Office of Naval Research 427, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0005, THEORETICAL STUDY OF RADIATIVE INTERACTION AND ENERGY TRANSFER PROCESSES OF MOLECULAR AND ATOMIC SYSTEMS
L.C. CHIU, Howard University, Graduate School, *Washington, District of Columbia* 20001 (E(40-1)-4048)

Theoretical studies of the rotational and vibrational energy transfer will be extended to include the exchange interaction between two interacting molecules. The extended theory is expected to improve the agreement between the calculated and the measured energy transfer cross sections. The 'forbidden' radiative transitions to the repulsive b3 sigma mu positive state via electric-quadrupole (E2) and magnetic- dipole (M1) interaction will be considered to be the decay mechanism for the metastable c3 pi mu state of H2. The decay rate will depend on the vibrational overlap weighted by the proper energy factor as well as the electronic-rotational matrix elements. A WKB semi-classical vibrational wave function which is generated by using the potential energy curve of Kolos and Wolniewicz will be generated for the repulsive b3 sigma-mu positive state. A general energy expression will be derived for the hyperfine level of a linear triatomic molecule with Renner effect in Pi electronic state. The lambda doubling effect, which is due to the rotational-electronic interaction with the nearby sigma state, will also be included in the treatment. The theoretical results will be applied to the microwave spectra of NCO and NCS to determine the molecular coupling constants.

RESULTS: Cross sections for V-V energy transfer have been recalculated for reaction N2(V equals O) plus CO2(001) by treating q- max(approximately 1/d) as an adjustable parameter. Preliminary results on vibrational overlap between C3 pi-mu (V equals (C3 pi-mu(V equals O) and repulsive b3 sigma mu positive has been calculated. Hyperfine energy expression has been obtained for vibronic state K equals V2 plus 1.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0006, PROPERTIES OF SUPERCONDUCTORS
D.M. GINSBERG, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (DMR76-80159)

Research under this grant will be a continuation of work begun under NSF Grant No. DMR73-07581. This project will investigate some of the properties of simple (non-transition) element superconductors with 3d-element magnetic impurities. The samples will be quench-condensed films. In such samples, the impurities provide localized magnetic moments which perturb the conduction electrons rather strongly. We will measure electron tunneling into these materials, and their critical magnetic fields and electromagnetic response functions (penetration depths). The results will help to test the theories of Shiba and of Muller-Hartmann and Zittartz, which go beyond the first Born approximation.

SUPPORTED BY U.S. Natl. Science Foundation

8.0007, APPLICATIONS OF ELECTRON-LATTICE COUPLING TO DYNAMICAL PHENOMENA IN SOLIDS
W.E. BRON, Indiana University, School of Arts & Sciences, *Bloomington, Indiana* 47401 (DMR76-23571)

Research previously supported under NSF Grant DMR72-03070 will be completed. The major areas under investigation will be: 1) Properties of broad- and narrowband phonon pulses generated by optical excitation of localized electronic states, by optical excitation of piezoelectric surface interactions, and by optical excitation of defect-induced and intrinsic lattice absorption; 2) Spectrographic analysis of phonon pulses and their interaction with localized electronic states; 3) The frequency dependence of various phonon scattering phenomena.

SUPPORTED BY U.S. Natl. Science Foundation

8.0008, THEORETICAL PARTICLE PHYSICS
A.W. HENDRY, Indiana University, Res. Division, *Bloomington, Indiana* 47401 (E(11-1)2009,0TASK B)

Our proposed program contains a balance of studies involving hadron collisions and investigations of quark models incorporating charm. In the first category, a partial wave analysis of pion-nucleon scattering up to 10 GeV/c is proposed, in order to extract information about high- mass, high-spin resonances; a cascade model for multiparticle production will also be developed. As regards quark models, we intend to consider various schemes which will produce the observed spectrum of states, including charmed particles, as well as a study of their production in collisions. Continued collaboration with the Indiana University experimental group (Task A) is anticipated as several of the experiments come to completion this year and new ones are developed.

RESULTS: We have obtained evidence for several new high-mass, high-spin resonances in pion-nucleon scattering, and examined high- energy collisions in the framework of Reggon field theory. We have also considered various quark model schemes to obtain the general electronmagnetic mass splittings among the mesons, the pion form factor and the magnetic moments of baryons.

Part 2 of 2.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0009, OPTICAL PROPERTIES OF SEMICONDUCTORS, MAGNETIC SEMICONDUCTORS AND FAR-INFRARED EMISSION FROM SEMICONDUCTORS
H.Y. FAN, Purdue University, School of Science, *Lafayette, Indiana* 47907 (DMR75-11178 A01)

Magnetic semiconductors-insulators and far-infrared radiation emitted by semiconductors are subjects of the proposed research. Magnetic properties enlarge the application potential of semiconductors, and they present challenging problems for scientific understanding. It is planned to study the optical Raman scattering by magnetic excitations in MnO, CoO and x-MnS. The study will be extended to other interesting crystals of simple structure, such as MnTe and NiS. Various characteristics of the scattering phenomena will be examined in order to determine the nature of different magnetic excitations and the relevant parameters of significance.

Some semiconductors may be induced to emit far-infrared radiation, in a wavelength range for which a convenient radiation

source is highly desirable. We have studied such emission from Ge, InSb, and GaAs which contained an impurity of small ionization energy. Charge carriers on the impurity were ionized by impact from conduction carriers under an accelerating electric field. The emission originated from recombination of the carriers. It is planned to study the conditions which affect the intensity and the spectrum of emission, including the specimen temperature and the applied electric field. Other materials and other methods of inducing emission will be explored. Attempts will be made to obtain stimulated emission which is interesting scientifically as well as important for applications.

SUPPORTED BY U.S. Natl. Science Foundation

8.0010, NAVIGATION - ATOMIC OSCILLATORS
N.F. RAMSEY, Harvard University, School of Arts & Sciences, *Cambridge, Massachusetts* 02138 (DN624041; N00014-76-C-0031)

This is a study in atomic processes and devices leading to extreme precision in measurement and use of frequency and time standards. Advances in such standards enable Navy to fulfill its prime responsibility to the Department of Defense in providing time and frequency services and lead to improved capabilities in navigation, IFF and air traffic control systems.

This investigation focuses on energy-level linewidth broadening in hydrogen, caused by impact by atoms of this gas on the walls of resonant cavities in which oscillations are sustained. This 'wall-broadening' results in radiation of varying frequencies emitted as jumps occur from the varying possible positions of wide energy levels. Accordingly, precision and resettability of masers which employ hydrogen gas is a function of this wall-broadening. Modifications will be made on a large storage box maser with a deformable bulb. The deformable bulb technique allows for very accurate wall shift measurements.

ADDENDA: Supporting agency address is: Office of Naval Research 421, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

8.0011, EXPERIMENTAL INVESTIGATIONS IN SOLID-STATE AND LOW-TEMPERATURE PHYSICS
A.M. GOLDMAN, Univ. of Minnesota, Inst. of Technology, *Minneapolis, Minnesota* 55455 (EY-76-S-02-1569)

SUMMARY: The proposed research consists of a program which includes studies of superconductivity, magnetism in metals and properties of liquid helium.

The research on superconductivity is aimed at understanding the dynamics of the superconducting order parameter and the fluctuations associated with the superconducting to normal transition. Investigations include the measurement of the pair field susceptibility and specific heat of superconducting films. Magnetic transitions are being studied through the characterization of superconducting fluctuations in proximity sandwiches consisting of superconducting and magnetic films. The conductivity of solid solutions of sodium in ammonia is also being investigated.

In the research on magnetism in metals, nuclear orientation and SQUID magnetometer techniques are being used to study Kondo systems at very low temperatures. Hyperfine enhanced nuclear cooling is being used in these studies and is itself being investigated.

The research on liquid helium consists of lambda transition and tricritical point in liquid 3He/4He mixtures and of the quantum properties of the flow and rotation of the superfluid component of liquid 4He. Included are the measurements of the differential osmotic pressure of 3He/4He mixtures, of the quantization of circulation of superfluid 4He, and of the dynamics of super fluid flow through pores in both liquid 4He and 3He/4He mixtures.

RESULTS TO DATE: Confirmed the existence of a propagating mode in the phase of the superconducting order parameter below Tc. This mode may be high-frequency second sound in superconductors. Observed a peak in the 'concentration susceptibility' of 3He/4He mixtures at the lambda line. Concentration susceptibility data have been found to obey simple tricritical scaling.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0012, HIGH-TEMPERATURE PROPERTIES OF LIQUID METALS AND VAPORS FOR NUCLEAR BREEDER AND FUSION POWER DESIGN
C.F. BONILLA, Columbia University, School of Engin. & Appl. Sci., *New York, New York* 10027 (EY-76-S-02-3027)

In 1976-77 it is proposed to complete the program on the direct determination of the isothermal compressibility of liquid sodium up to roughly 3000 F, well above the usual 1000 F limit of LMFBR safety calculations. It is also proposed to measure the vapor pressure of lithium to as high as possible with available equipment, and explore more refractory equipment as needed to reach the critical pressure and temperature, useful information for fusion reactor design. Other pertinent unavailable high-temperature properties of lithium, such as surface tension, are also projected.

Other studies, as time permits, include PVT data for cesium surrounding the critical point, for prediction of similar data for sodium, and high-temperature durability and impermeability of refractory metals for containment of hydrogen, deuterium and tritium, for fusion reactor design, and for nuclear hydrogenation of coal, etc.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0013, THEORY OF HEAVY-ION COLLISIONS
D. SPERBER, Rensselaer Polytechnic Inst., School of Science, *Troy, New York* 12181 (E(11-1)-3463)

The purpose of the proposed work is to study theoretically the interaction between heavy ions above the Coulomb barrier. It is suggested to study the cross section for completed fusion, the differential cross section for strongly damped collisions, and the mass and energy distribution for such collisions. The studies will use classical dynamics with dissipative forces, dynamical calculations together with random processes and semi-classical or quantum methods. The dynamical calculations will be generalized to allow for collective excitations of target and projectile. This goal will be reached in two different ways. First, phenomenological calculations will be performed in which different potentials are used in the entrance and exit channels. The modified potential in the exit channel is due to the collective excitations. Second, dynamical and static calculations will be performed including explicitly intrinsic collective excitations and necking. The program as a whole is geared toward a consistent interpretation of heavy-ion reactions and toward the analysis of the mounting experimental data concerning such reactions.

RESULTS: Simple, semi-classical models for complete fusion have been developed. A quantum time-dependent model for strongly damped collisions has been successfully tested. A model which accounts for strong damping and side peaking in the angular distribution has been developed. A dynamical model which allows for random transfer of matter has been developed and explains very well the angular distribution, mass distribution, and energy distribution for the reaction Kr plus Bi.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0014, STUDY OF THE STRUCTURE OF LIGHT NUCLEI WITH NEUTRONS
R.O. LANE, Ohio University, School of Arts & Sciences, *Athens, Ohio* 45701 (E(11-1)-2490)

The structure of light nuclei will be studied by means of their interaction with neutrons. The experimental program will include the elastic and inelastic scattering as well as polarization for neutrons interacting with 6Li, 7Li, 10B, 11B, 12C and 13C measured at the Ohio University Tandem Accelerator Laboratory by use of subnanosecond pulsed beams and time-of-flight methods. These results will enable us to improve our knowledge of the structure of light nuclei and develop further the various theoretical models for nuclear structure and nuclear reactions. These nuclei have important applications for measurement of cross sections and neutron fluxes.

RESULTS: A large set of data has been measured for the elastic and some inelastic scattering cross sections for neutrons scattered from 6Li, 7Li, 10B, 11B and 12C between 4 MeV and 8 MeV for angles from 20 degrees to 160 degrees using the Ohio University Tandem Accelerator. An R-Matrix program is now being written for extraction of level properties for the compound nuclei.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

8.0015, CONDUCTION PROCESSES IN FERROMAGNETIC METALS AND ALLOYS
L. BERGER, Carnegie Mellon University, Mellon Institute of Science, *Pittsburgh, Pennsylvania* 15213 (DMR75-23651 A01)

Research previously supported under DMR-7203093 will be continued. The thermal conductivity of ferromagnetic Fe-Si, Fe-Co, Fe-Ni, Ni-Co, and Ni-Cr alloys will be measured in fields up to 12 tesla at temperatures between 1 and 4.5 K. Also, measurements will be made of the Peltier coefficient of Fe-Si, Fe-Co, Fe-Ni, Ni-Co and Ni-Cr alloys between 1 K and 4.5 K, in fields up to 12 Tesla. This work can provide additional information on magnon-drag phenomena, and therefore on magnon-electron and magnon-impurity relaxation times.

Finally, an attempt will be made to force ferromagnetic domain walls to move, by passing a sufficiently large electrical current through a rod of very pure cobalt at 4 K. The walls are expected to reach speeds approaching the drift speed of charge carriers, and to move steadily in the same direction as these carriers. The existence of this 'domain-drag' effect can be detected by observing the deviations from Ohm's law which are predicted to take place.

SUPPORTED BY U.S. Natl. Science Foundation

8.0016, PHYSICAL ADSORPTION QUANTUM STATES ON SOLID SURFACES
D.R. FRANKL, Penn. State University, School of Science, *University Park, Pennsylvania* 16802 (DMR75-16603 A01)

The interaction of atoms and simple molecules with well-characterized solid surfaces will be investigated by means of molecular scattering experiments. The surfaces to be investigated include alkali halides, insulating oxides and chalcogenides, semiconductors and metals. The surface will be obtained by cleaving in situ in high vacuum. The surfaces will be characterized by low-energy electron diffraction (LEED) and Auger spectroscopy. Well-collimated He beams with velocity selection will be used for the scattering experiments.

SUPPORTED BY U.S. Natl. Science Foundation

8.0017, TRANSPORT PROPERTIES OF HIGH DENSITIES OF CHARGE CARRIERS IN SEMICONDUCTORS
M. GLICKSMAN, Brown University, Graduate School, *Providence, Rhode Island* 02912 (DMR76-80691)

Studies of the properties of semiconductors containing very high densities of photo-excited electrons and holes previously supported by NSF grant DMR72-02945 A03 will be continued. Work completed includes measurements of the conductivity of germanium containing electron-hole densities in the range 10 to the 13th power to 10 to the 18th power cm to the -3rd power, in the temperature range 1.8K to 298K. Comparison of these data with a calculation using a simple theory of electron-hole and electron-electron scattering shows fair agreement at densities where the electron-hole gas is non-degenerate. These studies will be continued by extension of the theory to include degeneracy and screening, and by experimental studies using gallium phosphide.

SUPPORTED BY U.S. Natl. Science Foundation

8.0018, PION-NUCLEON INTERACTION AT LAMPF - TASK A
G.A. REBKA, Univ. of Wyoming, School of Arts & Sciences, *Laramie, Wyoming* 82071 (EY-76-S-02-2197)

Muonic and pionic atom measurements will be continued at LAMPF. The muonic and pionic measurements should complement each other both with nuclear structure measurements and with QED tests. The muon is an almost purely electromagnetic probe, whereas the pion is a strong interaction probe as well as electromagnetic. Any discrepancy in energy observed with muons can be checked by a measurement with pions. At present, as the beam is improving, we plan to continue analysis on the available data as well as a few conventional measurements on distorted nuclei. It is hoped a not much used test beam can be improved into a more useful experimental beam.

Antiprotonic X rays in hydrogen at BNL will be observed for the basic interaction of antiprotons with protons. The measurements should yield the low-energy scattering length or phase shift. The X rays from sigma-minus atoms should yield a better value of the magnetic moment when the more intense stopping beam becomes available.

The results from LAMPF include some determinations of nuclear charge distributions (Qo, pi zero) of high atomic number distorted nuclei. The results from BNL include determinations of p and negative sigma magnetic moments and some strong interaction effects in high atomic number p atoms.

Part 1 of 2.

SUPPORTED BY U.S. Energy Res. & Dev. Admin. - P.R.D.

SOCIAL SCIENCES

Includes Social Sciences (general); Administration and Management; Documentation and Information Science; Economics and Cost Analysis; Law and Political Science; and Urban Technology and Transportation.

9.0001, FIBER OPTIC COST ANALYSIS PROGRAM (FOCAP)
R.H. REID, Rockwell International Corp., *Los Angeles, California* 90009 (DF105850; F33615-76-C-1260)

Current a/c data transfer systems are heavy, susceptible to EMP, lightning, EMI, exhibit low reliability and are very expensive. It is believed that the implementation of fiber optic technology can improve airborne internal data transfer performance while reducing existing deficiencies. The objective of this program is to analyze the economic proposition of replacing current hardwire data transfer systems with fiber optic data transfer systems on a selected aircraft. Both far-term and near-term fiber optic applications will be addressed.

Current costs of hardwire data transfer systems will be defined for the selected aircraft. Costs associated with EMI and EMP protection, electrical isolation, connectors, special cables, volume occupation, weight, data handling requirements, installation, operation and maintenance, and special requirements, will be defined for current wire- type systems and compared with a data transfer scheme supported by fiber optic technology. Fiber optic cost considerations will be based on near- term (involving dedicated point-to-point and multiplexed point-to-point data links) and far-term (fiber optic data bus utilizing passive optical couplers) applications. Cost savings or additional expenses as a result of using fiber optic data transfer systems will be derived as a function of time, thereby indicating the degree of development impetus required for minimum cost to the government. Qualitative cost figures will be made available for the determination of incorporating fiber optic technology into selected AF data transfer systems.

ADDENDA: Supporting agency address is: AF Avionics Laboratory AAT, Wright-Patterson AFB, Ohio 45433

SUPPORTED BY U.S. Dept. of Defense - Air Force

9.0002, PROGRAM MANAGEMENT FORMULATION FOR TRANSITION TO ADVANCED DEVELOPMENT OF AIRCRAFT STRUCTURES
A.P. URBAN, Telcom Incorporated, *Arlington, Virginia* 22204 (DN590161; N00019-76-C-0501)

Economic benefit evaluation of introducing advanced composite aircraft structures into service use.

Analysis of options available for transition of composites to advanced development and production use versus cost of transition effort.

ADDENDA: Supporting agency address is: Naval Air Systems Command, Washington, D.C. 20361

SUPPORTED BY U.S. Dept. of Defense - Navy

SPACE SCIENCES

Includes Space Sciences (general); Astronomy; Astrophysics; Lunar and Planetary Exploration; Solar Physics; and Space Radiation. For Related Information See Also Geosciences.

10.0001, TARGET SURVEILLANCE, COMMAND CONTROL AND COMMUNICATIONS, FORECAST, PREDICTION OF SOLAR FLARES

G.E. BRUECKNER, U.S. Navy, Res. Laboratory, *Washington, District of Columbia* 20375 (DN920046)

A capability is needed to forecast increases in solar short-wavelength radiation (solar flares) and in solar particle emission, since these produce ionospheric and geomagnetic disturbances which adversely affect radio communication, over the horizon radar, guidance- control, and detection.

Instrumentation is flown in rockets and satellites to determine the effects of flare activity on the sun's ultraviolet spectrum. Also, time- resolved images of flaring solar regions are recorded in their ultraviolet emission wavelengths to study the flare mechanism and to discover the causes of flares. The solar corona is monitored, to record particle ejections from the sun, and to study the conditions under which these are reliable predictors of particle-induced disturbances at earth. New instruments for data processing and for detection of extreme ultraviolet radiation are developed.

ADDENDA: Supporting agency address is: Naval Research Laboratory (7000), Washington, D.C. 20375.

SUPPORTED BY U.S. Dept. of Defense - Navy

10.0002, OPTICAL AND RADIO STUDIES OF DIFFUSE INTERSTELLAR CLOUDS

R.M. CRUTCHER, Univ. of Illinois, School of Liberal Arts & Sci., *Urbana, Illinois* 61801 (AST76-20810)

A three-fold observational attack on important problems in understanding the physics and chemistry of diffuse interstellar clouds will be carried out. Further observations of the OH lambda 3078 interstellar line and searches for the NH lambda 3358 line will be made in order to test ion-molecule versus grain surface formation theory. Anomalously low Na (I) ratios have been measured toward four stars near the rho Oph dust cloud, which suggests that enhanced depletion onto grains has taken place, in agreement with the larger-than-normal grains found in this region. Observations are planned of Na (I) K (I) ratios toward more reddened stars near this dust cloud and toward stars in other regions for which extinction data suggest large grains. The goal will be to achieve a better understanding of the process of element depletion onto grains from the interstellar gas. Radio observations of CO, OH, and H (I) toward OB stars will be made in order to study the spatial extent of diffuse clouds which produce optical absorption lines in the stellar spectra. One goal of these observations will be to study the relationship of the stars and the diffuse clouds of carbon monoxide. Mapping could show the velocity pattern predicted by dense expanding shell theory. Observations of carbon recombination lines toward stars with measured C (I) column densities are planned. This study will yield a direct measurement of the radiation field in the clouds. The result of the observations will be a better knowledge of molecular formation processes, grain formation, spatial extent, and possible evolution of diffuse clouds in the Galaxy.

SUPPORTED BY U.S. Natl. Science Foundation

10.0003, EMPIRICAL DETERMINATION OF VARIABLE STAR DISTANCES AND RADII (ABBREV)

T.J. MOFFETT, Purdue University, Graduate School, *Lafayette, Indiana* 47907 (AST76-20841)

Among the most sought-after stellar parameters is the distance to various celestial objects. Nearly every astrophysical research endeavor depends at least implicitly upon a reliable stellar distance scale. It is the purpose of this investigation to construct appropriate instrumentation and to examine a new distance determination method advanced by Barnes and his colleagues. The method is based upon an observed tight correlation between a star's visual surface brightness and its V-R (visual minus red magnitude) color index. The relation seems to be valid for all stars of measured angular diameter. From available visual and red brightness measurements, together with velocity in the line of sight measurements, Barnes and his colleagues found that they could derive both the linear diameter and distance of the classical cepheid variable star, Delta Cephei. The method is important because it is completely independent of all other distance scales. It has advantages of insensitivity to errors in the interstellar extinction and insensitivity to phase misalignments between the photometry and the radial velocities. This research, then, will explore the breadth of applicability of this new stellar distance determination technique.

A collaborative investigation by Purdue University and the University of Texas at Austin.

SUPPORTED BY U.S. Natl. Science Foundation

10.0004, COMMUNICATIONS - SOLAR RADIATIONS IN NEAR SPACE, INTERACTIONS WITH THE MAGNETOSPHERE AND IONOSPHERE, AND EFFECTS ON NAVAL COMMUNICATIONS

J.A. VANALLEN, Univ. of Iowa, School of Liberal Arts, *Iowa City, Iowa* 52240 (DN624361; N00014-76-C-0016)

The performance of naval communications, surveillance, detection and navigations is degraded or completely disrupted by ionospheric disturbances produced by the interaction of cosmic and solar radiation with the ionosphere. This work will provide quantitative information on the radiation environment of near space, on the interaction of solar particles and X-rays with the earth's ionosphere, and an increased understanding of the causes of magnetic storms, auroral and ionospheric disturbances, and communication blackouts.

Emphasis is on: corpuscular radiations trapped or transiently present in the earth's magnetic field, and solar, interplanetary and terrestrial phenomena associated with these radiations (e.g., solar flares, aurorae, geomagnetic storms, heating of the atmosphere and ionospheric effects of particle precipitation); energetic solar electrons: solar X-rays; very low frequency (vlf) radio phenomena in the magnetosphere; radio frequency emissions fron the sun and flare activity; and interactions of the solar wind with the magnetosphere.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

10.0005, OBSERVATIONS AND THEORETICAL INVESTIGATIONS OF PULSARS

J.H. TAYLOR, Univ. of Massachusetts, School of Arts & Sciences, *Amherst, Massachusetts* 01002 (AST75-23581 A01)

Studies will be continued on pulsars. The Arecibo antenna will be used during two sessions in order to obtain further timing information on the binary pulsar discovered by one of the principal investigators. An analysis of data on pulsars observed during the previous year will be carried out. Further observations to determine the space density and galactic distribution of pulsars will be done at the Molonglo Observatory, Australia. The University of Massachusetts - Arecibo pulsar survey will be continued. Theoretical work on the polarization properties of the pulsar emission mechanism taking into account plasma effects will continue. This is the second year of the two-year continuing grant AST 75-23581.

SUPPORTED BY U.S. Natl. Science Foundation

10.0006, NAVY ENVIRONMENT - SOLAR TERRESTRIAL STUDIES

D.E. OLSON, Univ. of Minnesota, Graduate School, *Duluth, Minnesota* 55812 (DN524476; N00014-75-C-0231)

In the interest of extending the naval weather forcast through correlation of solar and terrestrial events, the objective of this research is to seek the mechanism by which the local power density in the electrical field (which is independent of local atmospheric electrical conductivity) is increased after a solar flare.

Data on the electric field and current density at various sites around the auroral oval are being accumulated to adduce if there are systematic modulation as a geographic location moves through the dawn- to-dusk sectors. During magnetically disturbed times, modulation may be considerably greater and observed at sites farther south. These data would be used to map the electric field across the polar cap and down into the stratosphere and for correlation studies with meteorological data.

ADDENDA: Supporting agency address is: Office of Naval Research, Arlington, VA 22217

SUPPORTED BY U.S. Dept. of Defense - Navy

10.0007, INVESTIGATION OF THE SOLAR MAGNETIC CYCLE ANISOTROPY OF COSMIC RADIATION
S.E. FORBUSH, Franklin Inst. of State of Pa., *Swarthmore, Pennsylvania* 19081 (ATM75-23248)

The solar magnetic cycle manifests itself as a change in the annual mean diurnal variation in cosmic rays extending over a period of two sunspot cycles. Because the characteristics of the current phase of the twenty-year variation are anomalous, it is desirable to extend for a final three-year period the ionization chamber observations at Fredericksburg, Huancayo, and Christchurch that have been conducted continuously and systematically since 1936. In view of the broad implications of the solar magnetic cycle anisotropy, the analysis of these measurements, and their interpretation in the light of theoretical predictions, are of importance to solar-terrestrial research. The purpose of this award is to finish this analysis and study the cyclical behavior of the (magnetic) properties of the sun.

SUPPORTED BY U.S. Natl. Science Foundation

10.0008, ASTROMETRIC STUDIES OF NEARBY STARS FROM THE SOUTHERN HEMISPHERE
P.A. IANNA, Univ. of Virginia, School of Arts & Sciences, *Charlottesville, Virginia* 22903 (INT75-22605 A01)

This award provides for the continuation of a cooperative program begun in January 1976 with scientists at the Australian National University's Mt. Stromlo and Siding Spring Observatory for the determination of the trigonometric parallaxes and proper motions of astrophysically important nearby stars in the southern hemisphere. Parallax and proper motions of nearby stars are important in furnishing distances and motions which permit deriving the true luminosity and, with other data, the masses of stars in double star systems, contributing to knowledge of the sun's neighbors. Motions furnish data for understanding the structure of the Milky Way galaxy. Astrometric measures also furnish the yardstick for calibration of the cosmic distance scale.

The photographic observations, which are focusing on subluminous red stars, white dwarfs, and Hyades members, are being obtained with the Mt. Stromlo 26-inch refractor and subsequently measured and reduced at the University of Virginia's observatory. A special effort is being made to coordinate the photographic observations of a small sample of stars accessible to both McCormick and Mt. Stromlo. The observations are being made primarily in January, to get the Hyades stars in the evening sky, and May through December, to cover the south galactic pole region with both morning and evening observations.

This affords a unique opportunity for a detailed data comparison between a northern and a southern hemisphere refractor and an astrometric reflector, and hence an opportunity to investigate the sources of accidental and systematic errors in stellar parallaxes. The Australian principal investigator is O.J. Eggen.

SUPPORTED BY U.S. Natl. Science Foundation

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01 AERONAUTICS (GENERAL)

N77-22042# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD HIGHLIGHTS 75/1, MARCH 1975
Mar. 1975 25 p
(AGARD-Highlights-75/1) Avail: NTIS HC A02/MF A01

Various aspects of research and development in aerospace sciences are discussed. Specific topics considered include: (1) the impact of active control technology on aircraft design; (2) development of calculation methods for oscillating wings in subsonic flow; (3) technological and economic growth in aeronautics in relation to private and government funded research; and (4) the use of computer programs in aircraft design. J.M.S.

N77-22043# Advisory Group for Aerospace Research and Development, Paris (France).
AGARD HIGHLIGHTS 75/2, SEPTEMBER 1975
Sep. 1975 20 p
(AGARD-Highlights-75/2) Avail: NTIS HC A02/MF A01

Scientific and technological developments expected in the next 10 to 15 years in the field of fluid dynamics are discussed. Computational fluid dynamics, wind tunnel scale effects and testing techniques, and design of fuel conservative aircraft are considered. Special emphasis is given to advancement in semiconductor technology and development of microprocessors and charge coupled devices in relation to military applications of such technology to electronic warfare and custom design of large scale integrated circuits. J.M.S.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N77-22044# Georgia Inst. of Tech., Atlanta. School of Aerospace Engineering.
A THEORY OF THE SUPERSONIC TURBULENT AXISYMMETRIC NEAR WAKE BEHIND BLUFF-BASE BODIES
Gopal K. Mehta and Warren C. Strahle 1 Dec. 1976 50 p refs Backup document for AIAA synoptic scheduled for publication in AIAA journal, Aug. 1977
Avail: NTIS HC A03/MF A01

An integral method is presented for the solution of the near wake problem in supersonic flight for the case of fully turbulent, axially symmetric flow behind bluff-base bodies. The method is an extension of the developments in wake flow associated with the names of Crocco-Lees, Reeves-Lees and Alber-Lees. Comparison is made with available data, and good agreement is obtained. The motivation of the theory is to provide a computationally fast, yet reasonably accurate, base flow theory for later use in external burning studies. The current theory is for the case of adiabatic flow, including the effects of base bleed. Author

N77-22045*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VORTEX ATTENUATION METHOD Patent Application
Delwin R. Croom, inventor (to NASA) Filed 19 Oct. 1976 16 p
(NASA-Case-LAR-12034-1; US-Patent-Appl-SN-733814) Avail: NTIS HC A02/MF A01 CSCL 01A

The invention relates to providing trailing vortex wake attenuation for a large, multi-engine aircraft. It relates to deploying, throughout a landing approach, selected segments of flight spoilers mounted upon the upper, rearward surfaces of the wings of a large, multi-engine aircraft to thereby disrupt the generation of hazardous trailing vortex wakes. NASA

N77-22046*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ACOUSTIC TESTS OF AUGMENTOR WING MODEL
Jack H. Goodykoontz Washington Apr. 1977 56 p refs
(NASA-TM-X-3519; E-8923) Avail: NTIS HC A04/MF A01 CSCL 20A

Acoustic and aerodynamic data were obtained for a full-scale section of an augmentor wing. Features of the design included a single-row, multielement nozzle array and acoustically tuned panels placed on the interior surfaces of the augmentor. When the data were extrapolated to a 91,000-kilogram aircraft, the calculated sideline perceived noise levels were approximately the same for either the takeoff or approach condition. Author

N77-22047# National Aerospace Lab., Tokyo (Japan).
APPROXIMATE METHOD FOR CALCULATING AERODYNAMIC LOADINGS ON AN AIRFOIL OSCILLATING IN HIGH SUBSONIC FLOW
Koji Isogai May 1976 12 p refs
(NAL-TR-455T) Avail: NTIS HC A02/MF A01

The nonlinear effect (non-uniformity in the local Mach number of the mean steady flow) is taken into account. The range of reduced frequency, k, for which the present method can be applied, is k is greater than or equal to o and less than or equal to 0.3. The integral method is applied to derive the integral equation for an unknown load distribution, to be solved by iteration. The doublet lattice discretization technique is employed to reduce the integral equation to a system of algebraic equations. Unsteady load distributions on a NACA-64Q006 airfoil with an oscillating flap are calculated and compared with those predicted by existing theories and experimental results. Author

N77-22048# Virginia Univ., Charlottesville. Dept. of Engineering Science and Systems.
AERODYNAMIC STABILITY TESTING WITH MAGNETICALLY SUSPENDED MODELS Final Report, 1 Mar. 1974 - 31 Aug. 1976
Desikan Bharathan, Sam S. Fisher, and Ricardo N. Zapata Sep. 1976 135 p refs

(Grant AF-AFOSR-2705-74; AF Proj. 9783)
(AD-A031473; UVA/525603/ESS76/101; AFOSR-76-0036TR) Avail: NTIS HC A07/MF A01 CSCL 14/2

The practicality of measuring aerodynamic stability derivatives using models suspended in the University of Virginia water-cooled electromagnetic suspension facility is examined. Two non-spinning models are tested in pitch and heave oscillations in a subsonic flow, and both static and dynamic derivatives are determined from the measurements. The two models are 7-caliber and 5-caliber cone cylinders. For the tests, M = 0.071 and Red = 13,000. Pitch and heave oscillatory motions are induced by forcing the model laterally with its center of mass displaced from its center of magnetization. Each model's response is measured in a frequency range near pitch resonance. GRA

N77-22049# Aerospace Corp., El Segundo, Calif. Concepts and Plans Group Directorate.
TRANSITION INDUCED BY DISTRIBUTED ROUGHNESS ON BLUNT BODIES IN SUPERSONIC FLOW Final Report
William M. Bishop 29 Oct. 1976 58 p refs
(Contract F04701-76-C-0077)
(AD-A032009; TR-0077(2550-15)-1; SAMSO-TR-76-146) Avail: NTIS HC A04/MF A01 CSCL 20/4

An empirical model has been developed that correlates transition due to distributed roughnesses, which range in height over five orders of magnitude. The data base is obtained from wind tunnels, arc heaters, and sounding rockets. The shapes included are hemispheres, biconics, and laminar stable. The correlation departs from previous attempts by dividing the body into two distinct regions: a forward region where concave streamline curvature dominates transition, and a following region where streamline curvature is not an influence. Noise is found to have little or no effect, and the extension of the correlation to roughnesses measured in microinches shows no observable smooth wall limit. Author (GRA)

N77-22050# Martin Marietta Labs., Baltimore, Md.
INTEGRATING OF THE 3-D HARMONIC KERNEL Interim Report
Peter F. Jordan Aug. 1976 27 p refs
(Contract F44620-73-C-0041; AF Proj. 9781)
(AD-A033075; MML-TR-76-46C; AFOSR-76-0948TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Currently, the singular integral that arises in the analysis of oscillating lifting surfaces is evaluated by approximate methods, and considerable scatter exists between the results of different methods. In this paper, the application of an accurate approach to the Falkner finite element method is described, and some numerical results are compared with two current levels of approximation. Author (GRA)

N77-22051# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio. Flight Control Div.
SUBSONIC AND TRANSONIC SIMILARITY RULES FOR JET-FLAPPED WINGS Final Report, Jan. - Dec. 1975
Henry W. Woolard Oct. 1976 57 p refs
(AD-A033550; AFFDL-TR-76-86) Avail: NTIS HC A04/MF A01 CSCL 01/1

Linear-subsonic and nonlinear-transonic similarity rules are derived for a finite-span jet-flapped wing with partial or full-span blowing. Although some subsonic rules previously have been published for jet-flapped wings, those presented herein are more general. The nonlinear transonic rules are new. The rules for both flow regimes employ a new jet-sheet compatibility condition that is second order relative to the jet-sheet internal flow and yields a jet-momentum coefficient similarity parameter differing from the conventional parameter in that it includes the effect of the jet-supply pressure ratio. The examples presented show that the second-order effect is significant only for conditions under which a convergent jet nozzle chokes at a relatively low free-stream Mach number, say, less than 0.5. The relation of the present rules to previously published rules for both blown and unblown wings is discussed briefly. The experimental data available for validation of the linear rules is rather sparse and is plagued with uncertainties regarding wind-tunnel interference corrections. Nevertheless, some comparisons with experiment are made and fair agreement is achieved. These comparisons revealed that camber-line effects associated with blowing could be significant in transonic applications. There is no experimental data of appropriate configurational simplicity and of sufficient in parametric variations to permit validation of the nonlinear rules. Author (GRA)

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N77-22052# Committee on Public Works and Transportation (U. S. House).
AVIATION SAFETY. VOLUME 1: AN INQUIRY INTO CERTAIN ASPECTS OF APPROACH AND LANDING WEATHER PHENOMENA AND COCKPIT-TOWER RELATIONSHIP PROBLEMS
Washington GPO 1976 205 p refs Hearings Before Subcomm. on Investigations and Review of Comm. on Public Works and Transportation, 94th Congr., 1st Sess., 30 Jul., 21-22 Oct. 1975
(GPO-70-501) Avail: Subcomm. on Investigations and Review

Major aspects of U.S. commercial and private aviation safety are explored. Cockpit/tower communication and relations, approach and landing situations, and destination-airport vicinity problems are discussed. A.R.H.

N77-22053# Committee on Public Works and Transportation (U. S. House).
AVIATION SAFETY. VOLUME 2: AIRCRAFT CABIN ENVIRONMENT
Washington GPO 1976 311 p refs Hearings before Subcomm. on Investigations and Review of Comm. on Public Works and Transportation, 94th Congr., 2d Sess., 3-5 Feb. 1976
(GPO-70-797) Avail: Subcomm. on Investigations and Review

Cabin safety problems and potentially dangerous passenger environment conditions are discussed with emphasis on the seating and safety of flight attendants. Topics explored include oxygen mask testing, smoke hoods, the use of china dishes and carts, and the serving of alcoholic beverages. A.R.H.

N77-22054*# California Univ., Berkeley. Inst. of Transportation Studies.
SHORT HAUL AIR PASSENGER DATA SOURCES IN THE UNITED STATES
Joan Al-Kazily, Geoffrey Gosling, and Robert Horonjeff Jun. 1977 174 p refs
(Grant NsG-2127)
(NASA-CR-152671; ITS-SR-76-1) Avail: NTIS HC A08/MF A01 CSCL 01A

The sources and characteristics of existing data on short haul air passenger traffic in the United States domestic air market are described along with data availability, processing, and costs. Reference is made to data derived from aircraft operations since these data can be used to insure that no short haul operators are omitted during the process of assembling passenger data. Author

N77-22055# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF US NAVY AIRCRAFT ACCIDENT RATES IN MAJOR AVIATION COMMANDS Technical Report, Jul. 1971 - Jul. 1974 M.S. Thesis
Lawrence Charles Bucher Sep. 1976 73 p refs
(AD-A031837) Avail: NTIS HC A04/MF A01 CSCL 01/2

Time dependent variable measures were obtained for all major aircraft accidents between July 1971 and July 1974. Using these time dependent variables and functional forms of these variables, a regression analysis was performed for each of eight major aviation commands. By using these functional forms of the variables, a relatively high amount of variance in aircraft accident rate was accounted for at a high confidence level in some commands. When reviewing the results of the eight major

commands considered, it was particularly noted that the variables most instrumental in explaining the variance in aircraft accident rate were not all pilot oriented but were variables interpreted as being related either to pilot experience level, pilot proficiency or aircraft condition. Author (GRA)

N77-22056# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF U. S. NAVY MAJOR AIRCRAFT ACCIDENT RATES BY AIRCRAFT TYPE M.S. Thesis
Gary Fredric Johnson Sep. 1976 53 p refs
(AD-A032379) Avail: NTIS HC A04/MF A01 CSCL 01/2

An analysis of U.S. Navy major aircraft accidents during the period Fiscal Year 1972-1974 was conducted. Forward (stepwise) Multiple Regression techniques were employed on a group of ten basic variables considered time dependent. The multiple regression techniques were employed to develop predictive equations for the dependent variable, Accident Rate with a view to determining which of the basic variable measures were significant in accident rate studies and if the variables are unique to a specific aircraft community or generally applicable to all aircraft. Aircraft considered independently were A-4, A-6, A-7, and F-4, additionally composites of Attack aircraft (A-3, A-4, A-5, A-6, A-7), Fighter aircraft (F-4 and F-8), Propeller aircraft (E-1, E-2, C-1, C-2, S-2, P-3, C-117, C-118, and C-130) and Helicopters (H-1, H-2, H-3, H-46, and H-53) were considered. Author (GRA)

N77-22057# Mitre Corp., Bedford, Mass.
MAC AIR CARGO DATA ENTRY: 2. PHOTOGRAPHY OF SHIPPING LABELS
S. L. Smith Aug. 1976 54 p refs
(Contract F19628-76-C-0001; AF Proj. 515B)
(AD-A031454; MTR-3066-Vol-2; ESD-TR-76-12-2) Avail: NTIS HC A04/MF A01 CSCL 09/2

In April 1975, MITRE personnel visited the MAC air cargo terminal at Dover Air Force Base to test the possibility of Photographing shipping labels of cargo being unloaded at the truck dock. This report describes the photographic technique used, the image quality obtained, and the problems encountered. Various factors are cited that contributed to the few instances of poor image quality. Statistics are presented relative to data items sometimes missing from shipping labels, to assist in future comparison of photography with other alternative modes of data capture at the truck dock. Author (GRA)

N77-22058# Mitre Corp., Bedford, Mass.
MAC AIR CARGO DATA ENTRY: 3. INITIAL TESTING OF ON-LINE TERMINAL, DIGITAL RECORDER, AND CHECKSHEET
S. L. Smith Aug. 1976 158 p refs
(Contract F19628-76-C-0001; AF Proj. 515B)
(AD-A031455; MTR-3066-Vol-3; ESD-TR-76-162-Vol-3) Avail: NTIS HC A08/MF A01 CSCL 09/2

A program evaluating the application of data capture techniques to the entry of shipping data at MAC air cargo terminals is in progress. As a part of this program, six airmen from the truck dock of the MAC air cargo terminal at Dover AFB participated at MITRE in tests comparing three alternative modes of data entry: an on-line keypad/display, a digital recorder, and manual checksheets. Data items were entered from photographed shipping labels simulating truck loads of cargo varying in shipment-to-piece ratio and availability of advance shipment information. Performance measures included data entry time required for each test load, for characteristic entry sequences, and for the input of individual data items. Accuracy of performance was measured in terms of the frequency of different entry errors in data content and format, and detection/correction of errors in advance data. Recorded evaluations by the MAC test operators confirmed a strong preference for the on-line mode for potential use in truck dock data entry. A follow-on program of laboratory and field testing is recommended. Author (GRA)

N77-22059# Modern Analysis, Inc., Ridgewood, N. J.
DEVELOPMENT OF RELIABILITY-BASED AIRCRAFT SAFETY CRITERIA: AN IMPACT ANALYSIS, VOLUME 1 Final Report, Apr. 1975 - Apr. 1976
M. Shinozuka Apr. 1976 141 p refs 2 Vol.
(Contract F33615-75-C-3066; AF Proj. 1367)
(AD-A032164; AFFDL-TR-76-36-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 20/11

The random stress processes, composite Gaussian or single Gaussian, are constructed on the basis of exceedance curves for different aircraft under various flight conditions. The fatigue crack propagations under such stress processes are estimated with the aid of fracture mechanics method. The crack propagation rate under random loading is assumed to be proportional to the expected value of a power of the range of stress intensity factor which is in turn proportional to the expected value of the same power of the rise and fall of the stress process involved. The residual strength is evaluated as a function of crack size either under the assumption of slow crack growth design or under the assumption of fail safe design. Two different models as to the basic mechanical nature of the crack are used for the analysis and their interrelationships are discussed. The first is the crack initiation model in which a crack of certain size is assumed to initiate at 'randomly distributed time' and then propagate in accordance with the propagation law of fracture mechanics; the other is the pre-existing crack model which assumes the initial existence of 'a crack of random size' that propagates immediately upon application of the stress process. With the aid of the random process theory, the failure rate is evaluated as the expected rate of upcrossing of the residual strength by the stress. The probability of aircraft failure is obtained from the failure rate taking into consideration the effect of inspection procedures and proof loads. GRA

N77-22060# Modern Analysis, Inc., Ridgewood, N. J.
DEVELOPMENT OF RELIABILITY-BASED AIRCRAFT SAFETY CRITERIA: AN IMPACT ANALYSIS. VOLUME 2: COMPUTER MANUAL Final Report, Apr. 1975 - Apr. 1976
M. Shinozuka Apr. 1976 89 p 2 Vol.
(Contract F33615-75-C-3066; AF Proj. 1367)
(AD-A031951; AFFDL-TR-76-36-Vol-2) Avail: NTIS HC A05/MF A01 CSCL 20/11

The random stress processes, composite Gaussian or single Gaussian, are constructed on the basis of exceedance curves for different aircraft under various flight conditions. The fatigue crack propagations under such stress processes are estimated with the aid of fracture mechanics method. Numerical examples are worked out to illustrate the numerical significance of various analytical models and to indicate the sensitivity of the probability of failure to the parameters involved in the models. This volume contains computer program lists, input and output descriptions, input and output samples, flow charts and other data necessary for numerical work associated with the tasks described in volume 1. GRA

N77-22061# Naval Air Development Center, Warminster, Pa. Naval Navigation Lab.
FLIGHT TEST EVALUATION OF AVOID 2 (AVIONIC OBSERVATION OF INTRUDER DANGER) COLLISION AVOIDANCE SYSTEM Final Report
Patrick Finnegan 13 Oct. 1976 207 p refs
(Contract DOT-FA73-WAI-358)
(AD-A033596; NADC-76141-60) Avail: NTIS HC A10/MF A01 CSCL 01/4

AVOID is a candidate for a national standard collision avoidance system. A comprehensive flight and laboratory evaluation of the AVOID II version was conducted including the ability to communicate accurately and with sufficient distance to provide timely and correct advisories and maneuver commands in simulated high traffic density. Author (GRA)

N77-22062# Naval Ship Research and Development Center, Bethesda, Md.
QUAM: A SIMULATION MODEL FOR THE NAVY QUICK-TRANS SYSTEM USER'S MANUAL
Raymond E. Melton Nov. 1976 50 p
(AD-A033535; DTNSRDC-76-0136) Avail: NTIS HC A03/MF A01 CSCL 15/5

QUAM, the acronym for QUICKTRANS Airlift Model, is a computerized simulation of the Naval Quick Response Transportation System (QUICKTRANS) developed to permit forecasting of system operating costs, vehicle utilization, and route scheduling load factors for proposed routes and vehicles. This simulation,

written in FORTRAN 4, accepts (as input data) terminals, routes, cargo quantities, numbers of vehicles by type, and unit costs. The execution routines compute the time-distance-tonnage relationships for the stated input data to establish cargo loaded, transloaded, and off-loaded at each terminal; utilization for both vehicles (by type) and routes; costs per ton-mile, ton-milage, and both route and system operating costs. The output can provide the entire histographic record and/or management summaries in desired formats for information at terminals, along route segments, routes and for the entire system. The simulation has been used in the analysis of the requirements for servicing an expanded QUICKTRANS network. This report describes the model's logic elements and all the inputs needed by QUAM.
GRA

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N77-22063*# Ohio Univ., Athens. Avionics Engineering Center.
A MICROCOMPUTER-BASED LOW-COST OMEGA SENSOR PROCESSOR M.S. Thesis
Richard J. Salter, Jr. Feb. 1977 146 p refs
(Grant NGR-36-009-017)
(NASA-CR-145178; OU-TM-47(NASA)) Avail: NTIS HC A07/MF A01 CSCL 17G

The engineering approach used in the design of a low cost Omega sensor processor is discussed. The processor and its operations are described, as well as the system hardware and software. Circuit details of the hardware modules and program listings for the FORTRAN and microcomputer software are included. Author

N77-22064# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR DETECTION OF THUNDERSTORM HAZARDS FOR AIR TRAFFIC CONTROL. VOLUME 1: STORM CELL DETECTION
Robert K. Crane 7 Oct. 1976 59 p refs
(Contracts DOT-FA74WAI-485; F19628-76-C-0002)
(AD-A032732; FAA-RD-76-52-Vol-1; ATC-67-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17/7

A procedure was developed to detect hazardous regions within thunderstorms using weather radar data. The procedure is based upon the hypothesis that convective turbulence occurs within 2-3 km of relative radar reflectivity maxima (cells). The hypothesis was tested using a limited set of simultaneous aircraft and radar data. Analysis of precision radar data revealed that the cells are small in area extent, have a detection probability in excess of 0.9 using multiple radar scans, and are readily tracked for periods between 10 and 20 minutes. The characteristics of radar systems for acquiring data to support cell detection are discussed, and the role of Doppler spectral data is explored. Author

N77-22065# National Aviation Facilities Experimental Center, Atlantic City, N. J.
NAVAID SUPPORT OF HIGH-ALTITUDE AREA NAVIGATION ROUTES Interim Report, Jun. 1974 - Oct. 1976
Arthur G. Halverson and Floyd B. Woodson Feb. 1977 121 p
(FAA Proj. 044-326-010)
(AD-A036388; FAA-NA-76-49; FAA-RD-76-210) Avail: NTIS HC A06/MF A01 CSCL 17/7

The capability of the present system of navigational aids (NAVAID's) to support an area navigation (RNAV) route structure was determined. Coverage contours for each NAVAID were derived through application of radio line-of-sight (LOS) angles from the antenna to the surrounding terrain. A hypothetical high altitude RNAV structure was tested against the coverage contours of the NAVAID's presently used in the airspace at 18,000 feet and above. Each parent route and its related parallel offsets were checked for areas of excessive route width as well as for areas of noncoverage at a flight altitude of 18,000 feet. It is concluded that the present NAVAID system will support a high altitude RNAV route structure with only minor problems, principally in connection with route widths. Author

N77-22066# Federal Aviation Administration, Washington, D.C.
CONSULTATIVE PLANNING CONFERENCE ON AIRCRAFT SEPARATION ASSURANCE: PRESENTATIONS
27 Sep. 1976 148 p Conf. proc. held 27 Sep. 1976
(AD-A032354; FAA-ATF-4-76-1) Avail: NTIS HC A07/MF A01 CSCL 17/7

A review and analyses of pertinent statistical information on collisions and collision analyses, major separation assurance objectives, protection priorities, and methods of achieving objectives, are discussed. Existing air traffic control system, procedures and systems being used today related to aircraft separation are reviewed. Developmental approaches contain information on conflict alert in the terminal environment, Collision Avoidance Systems (CAS) including Airborne CAS (ACAS) and Beacon-Based (BCAS), Intermittent Positive Control (IPC) and Proximity Warning Indicator (PWI) systems. Information is given concerning FAA's selection of BCAS and IPC as the programs to pursue, as well as FAA's decision not to proceed with ACAS and PWI. The recommended five point aircraft separation assurance program includes the plans, proposed schedules, interrelationships with other programs, cost and present status of: (1) conflict alert in the terminal environment; (2) IFR flight plan requirements; (3) transponders and encoding altimeters; (4) BCAS; and (5) IPC. Author

N77-22067# Applied Physics Lab., Johns Hopkins Univ., Laurel, Md.
EXPERIMENTAL RESEARCH ON THE PROPAGATION OF LORAN-C SIGNALS. VOLUME C: THE MEASUREMENT SYSTEM
S. F. Oden and J. A. Perschy Aug. 1976 72 p ref
(Contract N00017-72-C-4401)
(AD-A031597; APL-JHU-TG-1298C) Avail: NTIS HC A04/MF A01 CSCL 11/7

This report describes the design, assembly, and electrical matching of two identical measurement systems that were used in an experiment conducted by APL for the U.S. Air Force and the Defense Advanced Research Projects Agency to determine the validity of one facet of the theory of groundwave propagation at 100 kHz. It is Volume C of four volumes. Volume A is the summary report, Volume B covers test operations, and Volume D documents the data and analysis. The goal of the experiment was to determine if an analytic function could be developed for operational use that relates secondary phase factor (SPF) to envelope to cycle difference (ECD) so that geodetic position can be computed accurately and in real time. Field test data were collected and analyzed and show trends that tend to support the hypothesis that the desired functional relationship exists, at least under certain conditions. Additional analysis and perhaps tests will be necessary to define these conditions or to prove conclusively the existence of such a relationship.
Author (GRA)

N77-22068# Advisory Group for Aerospace Research and Development, Paris (France).
PROPAGATION LIMITATIONS OF NAVIGATION AND POSITIONING SYSTEMS
Feb. 1977 340 p refs In ENGLISH; partly in FRENCH Conf. Proc. of the Electromagnetic Wave Propagation Panel Specialists' Meeting, Istanbul, 20-22 Oct. 1976
(AGARD-CP-209; ISBN-92-835-0189-6) Avail: NTIS HC A15/MF A01

The limitations that the propagation medium places on sea, air and ground navigation systems are discussed. For individual titles, see N77-22069 through N77-22094.

N77-22069# Aerospace Corp., El Segundo, Calif.
IONSPHERIC EFFECTS IN NAVSTAR GPS
Bradford W. Parkinson (SAMSO, El Segundo, Calif.), Edward M. Lassiter, and C. K. Cretcher *In* AGARD Propagation Limitations

of Navigation and Positioning Systems Feb. 1977 12 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

The impact of ionospheric effects upon user system performance in the positioning process is reviewed. System performance of ionospheric delay corrections in terms of ionospheric modeling and in terms of dual frequency receiver calibration are discussed. The effects of signal degradation by phase and amplitude scintillation are reviewed. Author

N77-22070# Army Electronics Command, Fort Monmouth, N.J. Communications/Automatic Data Processing Lab.
PLASMASPHERIC SIGNAL TIME-DELAY EFFECTS IN SATELLITE NAVIGATION SYSTEMS
H. Soicher *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 9 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Since delay time modeling efforts to date have been based on total electron count obtained by the Faraday rotation technique, the plasmaspheric delay is not compensated for and thus comprises a source of error. In an effort to determine the magnitude of this error, observations of plasmaspheric content were performed at a midlatitude station, an auroral station and a station in the vicinity of the geomagnetic equatorial anomaly. Diurnal, day-to-day, and latitudinal variations of the contents were observed. The ratio of the plasmaspheric-to-ionospheric contents varied substantially from day to night. Author

N77-22071# Air Force Geophysics Lab., Hanscom AFB, Mass.
IONOSPHERIC TIME DELAY CORRECTIONS FOR ADVANCED SATELLITE RANGING SYSTEMS
J. A. Klobuchar *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 13 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Some general comments are made concerning ionospheric time delay models, and a specific algorithm designed for the single frequency user of the NAVSTAR-Global Positioning System (GPS) is described in detail. Author

N77-22072# General Electric Co., Syracuse, N.Y.
TRANSIT SATELLITE OBSERVATIONS OF IONOSPHERIC IRREGULARITIES
George H. Millman and Roy E. Anderson (GE Co., Schenectady, N.Y.) *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 13 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

The characteristics of the phase fluctuations imposed by ionospheric irregularities on the 150- and 400-MHz coherent frequencies emanating from the polar orbiting U.S. Navy Navigation Satellites (TRANSIT) are evaluated in terms of the phase coherence of ionospheric propagation. In addition to the differential phase measurements, the two signal amplitudes were also recorded throughout the orbital passes. From the second derivative with respect to time of the differential phase fluctuations, an estimate is made of the nonlinear phase shift introduced by the ionosphere. For an assumed altitude of the irregularities, estimates are made of the overall spatial extent of the inhomogeneities producing the phase and amplitude fluctuations. By correlating radio optical observatory data with the differential phase and 150-MHz amplitude measurements recorded simultaneously, the two-dimensional spatial configurations of the irregularities responsible for the perturbations are deduced. From the differential phase data, the characteristics of the equatorward edge of the midlatitude trough are evaluated. A correlation is made of the equatorward edge of the trough with the equatorward edge of the phase and amplitude scintillation regions. Author

N77-22073# Naval Research Lab., Washington, D. C. Space Systems Div.
PROPAGATION EFFECTS OBSERVED IN CONNECTION WITH NTS-1 OBSERVATIONS NEAR THE MAGNETIC EQUATOR
Rudolph R. Zirm and John M. Goodman *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 19 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Amplitude and differential propagation delay scintillation of the 335 and 1,580 MHz transmissions from NTS-1 satellite were measured. The results obtained through analysis of amplitude and differential propagation delay data at 335 and 1,580 MHz are discussed. Several conclusions have been reached on the basis of analysis: (1) Severe scintillation activity was observed at 335 MHz for approximately four days out of a two week interval and varied from a few db to over 30 db, (2) no apparent scintillation was observed at 1,580 MHz, and (3) the differential delay scintillation was not observed to exceed two nanoseconds peak-to-peak. The smoothed differential delay information suggests the existence of an anomaly in the total electron content as the satellite passed over the magnetic equator. This feature is not inconsistent with currently accepted models of electron redistribution near the equator. Author

N77-22074# Air Force Geophysics Lab., Hanscom AFB, Mass.
IONOSPHERIC RANGE ERROR CORRECTION IN PRECISION RADAR SYSTEMS BY ADAPTIVE PROBING OF THE PROPAGATION MEDIUM
R. S. Allen, D. D. DuLong (Regis College, Weston, Mass.), M. D. Grossi (Raytheon Co., Sudbury, Mass.), and A. H. Katz (Raytheon Co., Sudbury, Mass.) *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 16 p refs (For primary document see N77-22068 13-04)
(Contract F19628-76-C-0094)
Avail: NTIS HC A15/MF A01

A real time adaptive scheme for ionospheric range error correction in precision UHF radars is based on the use of a model of the monthly median ionosphere constructed from existing worldwide climatology and on updating and correcting this model with real-time dual frequency measurements of the columnar electron content. The space-time cell in which the dual frequency correction maintains its validity is so large that a single dual frequency sample taken along a direction that cuts across the volume monitored by the radar as rarely as once every half hour still suffices. This requires that the adopted ionospheric model, while the solar cycle progresses, correspondingly becomes more and more sophisticated in such features as its reproduction of horizontal gradients. Author

N77-22075# Queensland Univ., St. Lucia (Australia). Dept. of Physics.
THE EFFECT OF RADIO LENSES IN THE IONOSPHERE ON THE SCINTILLATION OF SATELLITE-TO-GROUND RADIO SIGNALS
Kenneth Davies and J. D. Whithead *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 10 p refs Prepared in cooperation with NOAA, Boulder, Colo. (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

The radio beacon on board the geostationary satellite ATS6 emits phase coherent signals on frequencies near 40, 140, and 360 MHz. A particularly interesting phenomenon was observed characterized by the following features: (1) An almost total fade out of the amplitudes of the 40, 140 and 360 MHz signals; (2) asymmetric Fresnel-type fading of the signals on both sides of the deep fades, with periods of the order of 1 sec; and (3) a distinctive modulation of the diffraction (fading) pattern. The peculiar diffraction patterns have been simulated by the use of cylindrical lenses in the ionosphere which give Gaussian distributions of phase advance. The asymmetric fading pattern may be caused by one of two effects: An asymmetric cross section, or a cylinder expanding in time. Author

N77-22076# Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).
LOW ANGLE EFFECTS ON VHF AND UHF PROPAGATION DUE TO IONOSPHERE AND TROPOSPHERE (A REVIEW)
G. K. Hartmann *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 7 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

A literature survey is reported for low angle effects on VHF and UHF propagation due to ionosphere and troposphere. Main emphasis is given to effects which occur for satellite elevation

angles of less than 30 deg. The most important effect is due to scintillation. The effects due to antenna beamwidth and due to small changes of the medium within that 3 db cone are also discussed. Author

N77-22077# Royal Aircraft Establishment, Farnborough (England).
A REVIEW OF LF/VLF RADIO NAVIGATION SYSTEMS AND SOME RELATED PROPAGATION INFLUENCES
B. Burgess *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 5 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Radio navigational aids are reviewed that have been developed in the LF/VLF bands since the 1940s. Attention is paid to the operational requirement that is met by this type of aid and the effects that the propagation characteristics of the radio waves at these frequencies have on the performance of the aids. Author

N77-22078# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
EFFECTS OF IRREGULAR MEDIA ON NAVIGATION AND POSITIONING SYSTEMS: FULL WAVE SOLUTIONS
E. Bahar *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 15 p refs (For primary document see N77-22068 13-04)
(Grant DAHC04-74-G-0074)
Avail: NTIS HC A15/MF A01

Radio wave propagation over several irregular propagation paths is examined in detail. The phase anomalies, the delays and the distortions for pulsed radio signals transmitted across hills or valleys on the earth's surface are determined using a full wave approach. Author

N77-22079# Colorado Research and Prediction Lab., Boulder.
DISCUSSION OF REAL AND APPARENT LORAN-C PROPAGATION LIMITATIONS
R. H. Doherty *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 5 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Loran-C propagation limitations derived from measured data are related to the prediction model against which the data are analyzed. After measuring and analyzing Loran-C data throughout the world over a period of 20 years, it has become possible to recognize these analysis problems. Some examples of real versus apparent propagation type errors are presented to show the problems associated with certain analysis techniques. Also, an example of an unfounded assumption is used to show how errors in basic assumptions can affect the evaluation of the entire system's capability. Author

N77-22080# Colorado Research and Prediction Lab., Boulder.
PREDICTION OF GROUND WAVE PROPAGATION TIME ANOMALIES IN THE LORAN-C SIGNAL TRANSMISSIONS OVER LAND
J. Ralph Johler *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 7 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

The ultimate accuracy to which Loran-C can be predicted is dependent firstly upon the Loran chain grid including the measuring equipment and secondly upon the predictability. Prediction of the signal propagation time to full accuracy over land or over seawater involving land masses in the propagation paths to each of the transmitters requires special considerations. This means that spatial perturbations of the signal propagation time limit the prediction accuracy of the Loran coordinates (time differences). This limitation arises from the physical nature of the ground and its effect on wave propagation--land is nonhomogeneous and irregular. It is argued that such anomalous propagation is a unique function of the geographic location of the propagation path and requires the introduction of terrain, soil and basement rock electrical properties and features along the propagation path. Such detail is readily introduced into the modern solution of the ground wave propagation problem using an integral equation and computer data handling capabilities. Author

N77-22081# Air Force Geophysics Lab., Hanscom AFB, Mass. Electromagnetic Sciences Div.
LORAN C/D COORDINATE PREDICTION DEPENDENCE ON GROUND ELECTRICAL PROPERTIES
S. Horowitz and J. R. Johler (Colo. Res. and Prediction Lab., Boulder) *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 9 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

The time of arrival of a Loran pulse depends on the electrical properties of the earth's surface over which these signals propagate. These electrical properties include the impedance or conductivity of the ground, the roughness or terrain variations of the surface, the refractive index of the atmosphere at the surface, and the lapse rate or rate of change of refractive index with altitude above the surface. Spatial variations of the transmitted Loran signal are primarily influenced by the nonhomogeneous surface impedance and by variations in the terrain. Loran ground wave time of arrival calculations have been made in the presence of irregular and nonhomogeneous ground. The irregularities are represented by elevation data as a function of range from the ground transmitters to the receiver. The ultimate limitation in the reduction of the propagation error as a function of quality of data for different types of land paths is illustrated. Author

N77-22082# Norwegian Defence Research Establishment, Kjeller.
IONOSPHERIC EFFECTS ON LORAN-C IN POLAR REGIONS
T. R. Larsen and E. V. Thrane *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 8 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Loran-C is a radio navigation system using pulsed signals at 100 kHz. Interference between ground wave and waves reflected from the ionosphere can reduce the accuracy of this system. The reflecting properties of the ionosphere are variable, and irregular disturbances affecting these properties are particularly frequent in polar regions. Amplitude and time delay of a 100 kHz radio wave that is reflected from different ionospheric models are computed. These models simulate day and night conditions and conditions during a severe ionospheric disturbance. The computations indicate at which distance from a Loran-C transmitter the skywave interferes with the ground wave. Author

N77-22083# Naval Electronics Lab. Center, San Diego, Calif.
PROPAGATION EFFECTS ON OMEGA
E. R. Swanson *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 20 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

Special propagational effects including Sudden Phase Anomalies (SPA's) associated with Sudden Ionospheric Disturbances (SID's) and Polar Cap Absorptions (PCA's) are defined. Normal propagational conditions are emphasized, especially typical repeatability and typical diurnal behavior. Factors affecting the prediction of phase include characteristic velocity and phase variation with excitation of the waveguide mode, ground conductivity over a propagation path, variations with geomagnetic dip angle and path azimuth, effects of the aural zone and polar cap regions, and solar cycle variation of velocity. The zenith angle effect is shown to explain seasonal variations as well as most diurnal change. General propagational considerations are shown to represent the received OMEGA phase over 95% of the time. A few percent of the time, however, phase is shown to be abnormally perturbed due to SPA's on sunlit paths or PCA's on arctic paths. Note is made of the importance of single mode propagation by the same dominant mode throughout the day. Author

N77-22084# Services Technique des Phares et Balises, Bonneuil-sur-Marne (France).
DIFFERENTIAL OMEGA: TESTS AND DEVELOPMENT IN FRANCE
D. Abadie and P. Laurent (SERCEL, Nantes, France) *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 13 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

The operation of OMEGA radio navigation system worldwide coverage is locally improved as far as accuracy and reliability are concerned, by taking into account corrections by a fixed shore station called differential Omega station. The telemetering format used in France is described, and some experimental results obtained at the differential OMEGA stations on French coasts are given. Author

N77-22085# Leicester Univ. (England).

A COMPARISON OF THE CALCULATED AND MEASURED DAYTIME PROPAGATION CHARACTERISTICS OF THE OMEGA TRINIDAD TRANSMISSIONS

G. Foley, T. B. Jones, and B. Burgess (RAE, Farnbourough, Engl.) IN AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 8 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

Phase and amplitude of the 10.2 and 13.6 kHz transmissions from Omega Trinidad were measured in an aircraft flying radially away from, and then towards, the transmitter. Data were obtained during daytime for propagation in three azimuthal directions E-W, W-E and S-N. The variations of the phase and amplitude of both frequencies has been calculated for the three azimuthal directions, using a number of D-region models. The calculated variations are compared with the measured changes of phase and amplitude in order to assess the accuracy of the analysis procedure. Very close agreement is obtained the measured and calculated values of both phase and amplitude when the ionospheric model employed is similar to that suggested by Deeks. Other D-region models yield calculated values which do not show the same degree of agreement with those measured. It is possible to calculate accurately the phase and amplitude of both the 10.2 and 13.6 kHz transmission at any distance from the low latitude Omega Trinidad transmitter for daytime conditions. Author

N77-22086# Norwegian Defence Research Establishment, Kjeller.

OMEGA ACCURACY IN POLAR REGIONS DURING IONOSPHERIC DISTURBANCES

T. R. Larsen *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 16 p (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

Omega propagation variability studies at high latitudes show typically an r.m.s. variability of 4 to 9 centicycles at 10.2 kHz for hourly standard deviations grouped into 24-hour periods on a monthly basis. Highest variability was obtained during winter months. Phase difference observations during solar X-ray flares have been analyzed for the pair A-C received at Ny Alesund. The mean value of the phase offset (at 10.2 kHz) was 38 sec with a standard deviation of 11 sec. Offset in excess of 60 sec was recorded during initial hours of the event. Author

N77-22087# Transportation Systems Center, Cambridge, Mass.

SHORT RANGE NAVIGATION REQUIREMENTS FOR TRANSPORT SYSTEMS

Louis W. Roberts and George G. Haroules *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 31 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

The overall errors affecting the accuracy of radio navigation systems are discussed in terms of their impact on the requirement. Several scenarios typical of transport problems with their inherent accuracy requirements are also presented to emphasize the propagation problems that need to be satisfied as a function of frequency. A recently discovered principle of interferometry is submitted as a solution to solve the transport requirements. Author

N77-22088# Service Hydrographique et Oceanographique de la Marine, Paris (France).

LONG AND SHORT RANGE NAVIGATION SYSTEM REQUIREMENTS FOR CIVILIAN AND MILITARY SHIPS

A. M. Roubertou *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 10 p refs In FRENCH (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

A sophisticated system such as in the American project NAVSTAR could supply most basic navigation requirements if the short range factor were eliminated. An analysis of civilian and military needs shows that a unique system is not possible for short range navigation because of precision requirements and national preoccupations. Existing short range systems are classed and analyzed from the point of view of adaptation to recognized needs, and the various categories of users. Trans. by A.R.H.

N77-22089# SERCEL, Nantes (France).

SYLEDIS, A RADIOPOSITIONING SYSTEM

P. Laurent and G. Nard *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 10 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

A pulse system has been developed, named SYLEDIS, which does not rely on radar techniques. The use of compression of long pulses by correlation methods, and of a carrier wave in the 420-450 MHz band, has resulted in a highly accurate system, insensitive to soil conductivity, exhibiting no ambiguity problem, capable of ranges of 2 or 3 times the line of sight and not limited by obstacles of reasonable size. Author

N77-22090# Leicester Univ. (England). Dept. of Physics.

APPLICATIONS OF THE DOPPLER TECHNIQUE AS AN AID TO BEARING MEASUREMENT

T. B. Jones and C. T. Spracklen *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 10 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

A Doppler system is described which provides an indication of the presence, or absence, of TID's even when a short-duration nonfrequency stable transmission is monitored. Thus, a good/bad bearing indication can be given and some assessment of the likely variances in the measured bearing predicted. When more than one propagation mode is present multiple frequency shifts are observed in the received signal. These are easily identified, and the system is an efficient monitor of multimode conditions. The application of this Doppler technique has led to an improvement in the performance of a wide aperture direction finder; moreover, it is possible to estimate the expected variances from the Doppler observations. Author

N77-22091# Max-Planck-Institut fuer Aeronomie, Lindau Uber Northeim (West Germany).

POSITION FINDING OF FIXED HF-TRANSMITTERS BY MEANS OF TRAVELING IONOSPHERIC STRUCTURES

J. Roettger *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 12 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

It is assumed that the parameters of a traveling ionospheric structure or disturbance, like velocity and azimuth of propagation, are deduced by a measurement of the Doppler shift using a known array of three transmitters and one common receiver. The cross-correlation of the signals of the known array with the unknown signal yields the position of the unknown transmitter by applying some geometrical calculations. The basic method to evaluate the signal variations by means of the cross-correlation and cross-spectrum technique is described. Calculations based on appropriate models of traveling ionospheric structures are carried out to prove the applicability of the introduced method. Some implications on the accuracy and reliability of the position determination are considered. Author

N77-22092# Standard Electrik Lorenz A.G., Stuttgart (West Germany).

A SIMPLE MULTIPATH ERROR REDUCTION METHOD FOR SINGLE SITE DF SYSTEMS

M. Boehm *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 12 p refs (For primary document see N77-22068 13-04)

Avail: NTIS HC A15/MF A01

Multipath error reduction by aperture sampling uses at least three antenna elements. This method is derived from a simple error model that is independent from frequency. At each of the three elements phase and amplitude of the electromagnetic field

are sampled simultaneously by providing each antenna element with its own receiver. The phase/amplitude pairs are digitized and fed into a computer for processing. The basic method is applicable to linear as well as circular arrays. In order to evaluate the method an L-band test system was built, featuring a five lambda linear array. Author

N77-22093# National Committee for Space Research, Haifa (Israel).
SINGLE FREQUENCY USE OF THE NAVY NAVIGATIONAL SATELLITE SYSTEM
Abraham Shuval and Jonathan Mass *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 10 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

In the Navy Navigational Satellite System (NNSS), simultaneous transmission and reception on two frequencies are normally used in order to overcome the navigation error caused by the ionosphere. The navigation error caused by the ionosphere while using one frequency only is investigated. Several ways to reduce the navigation errors, while receiving on one frequency only, are discussed. It is shown that one frequency only (400 MHz) could be used if a small increase in average time between navigation fixes and an accuracy of about 200 m are tolerable. Author

N77-22094# Decca Navigator Co. Ltd., Surrey (England). Dept. of Operational Research and Computer Systems.
A STUDY OF SUDDEN IONOSPHERIC DISTURBANCES AND THEIR EFFECT ON VLF POSITION FIXING ACCURACY
M. E. Perry *In* AGARD Propagation Limitations of Navigation and Positioning Systems Feb. 1977 12 p refs (For primary document see N77-22068 13-04)
Avail: NTIS HC A15/MF A01

With the concentration of air traffic over the North Atlantic organized track structure area it has become necessary to ensure that aircraft do not stray from the specified track by more than given amounts. The positional errors that may be encountered by an aircraft using the Omega system in this area during periods of high solar activity are determined. Omega phase records from many sources have been analyzed to give an approximate frequency and propagation path dependence. These dependencies have been used to convert the collected data to a normalized form to determine the approximate errors observed at any point in the North Atlantic Area. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N77-22095# Kansas Univ., Lawrence.
FLIGHT TEST DATA FOR LIGHT AIRCRAFT SPOILER ROLL CONTROL SYSTEMS
David L. Kohlman 1977 28 p refs Presented at Business Aircraft Meeting, Wichita, Kansas, 29 Mar. - 1 Apr. 1977; sponsored by Soc. of Automotive Engr.
Copyright. Avail: NTIS HC A03/MF A01

The results of flight tests to determine the characteristics of spoiler roll control systems on three different light aircraft are summarized. Comparisons are made with wind tunnel data where available. Flight tests indicate that excellent roll characteristics can be achieved with spoilers. Yaw coupling with roll control inputs is virtually eliminated. Roll rates remain high when flaps are deployed at low speed. Very mild nonlinearities in control effectiveness exist, and there was no deadband or lag detected. Author

N77-22096*# Aerospace Corp., El Segundo, Calif.
APPLICATIONS OF ADVANCED V/STOL AIRCRAFT CONCEPTS TO CIVIL UTILITY MISSIONS, VOLUME 1 Final Report
Feb. 1977 158 p refs 2 Vol.
(Contract NAS2-8710)
(NASA-CR-151987) Avail: NTIS HC A08/MF A01 CSCL 01C

The suitability of advanced V/STOL aircraft to civil utility applications was assessed for offshore oil support, forest fire support, transport, and humanitarian missions. The aircraft concepts considered were a lift fan aircraft, a tilt rotor aircraft, and an advanced helicopter. All the aircraft had a design payload of 2,268 kg. (5,000 lb.) with the maximum range varying from 2,224 km. (1,800 nm) for the lift fan STOL to 1,482 km (800 nm) for the advanced helicopter. The analysis of these missions considered such factors as aircraft performance, annual utilization, initial cost, and operating cost. It is concluded that all the advanced V/STOL aircraft concepts generally performed these missions better than contemporary aircraft. The lift fan aircraft and the tilt rotor aircraft were found to be effective for the offshore oil and the forest fire support missions. The lift fan aircraft in the VTOL mode was also found to be very attractive for the executive transport mission where the passenger time value was $30/hr. or more. Author

N77-22097*# Aerospace Corp., El Segundo, Calif.
APPLICATIONS OF ADVANCED V/STOL AIRCRAFT CONCEPTS TO CIVIL UTILITY MISSIONS. VOLUME 2: APPENDICES Final Report
Feb. 1977 196 p refs 2 Vol.
(Contract NAS2-8710)
(NASA-CR-151988) Avail: NTIS HC A09/MF A01 CSCL 01C

The linear performance definition curves for the lift fan aircraft, tilt rotor aircraft, and advanced helicopter are given. The computer program written to perform the mission analysis for this study is also documented, and examples of its use are shown. Methods used to derive the performance coefficients for use in the mission analysis of the lift fan aircraft are described. Author

N77-22098*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPUTER SIMULATION INCORPORATING A HELICOPTER MODEL FOR EVALUATION OF AIRCRAFT AVIONICS SYSTEMS
Aaron J. Ostroff and R. Brian Wood Washington Apr. 1977 43 p refs
(NASA-TM-X-3491; L-11200) Avail: NTIS HC A03/MF A01 CSCL 01C

A computer program was developed to integrate avionics research in navigation, guidance, controls, and displays with a realistic aircraft model. A user oriented program is described that allows a flexible combination of user supplied models to perform research in any avionics area. A preprocessor technique for selecting various models without significantly changing the memory storage is included. Also included are mathematical models for several avionics error models and for the CH-47 helicopter used in this program. Author

N77-22099# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
A REVIEW OF THE ANALYSES OF HYDRODYNAMIC RAM Interim Report, Aug. 1973 - Sep. 1974
Philip F. Fry Aug. 1976 182 p refs
(AD-A031996; AFFDL-TR-75-102) Avail: NTIS HC A09/MF A01 CSCL 19/4

Analytical models applicable to hydrodynamic ram studies are reviewed. These include Stepka and Morse's observations of shock formation, Yurkovich's analysis of the shock, and Lundstrom's analysis of the fluid drag pressures. Several approaches to the wall analysis are also reviewed; these include Chou's use of the method of characteristics, and Ball's adaptation of piston theory. Finally, damage reduction methods are also discussed. Author (GRA)

N77-22100# Calspan Corp., Buffalo, N.Y.
A STUDY TO DETERMINE THE FEASIBILITY OF SIMULATING THE AV-8A HARRIER WITH THE X-22A VARIABLE STABILITY AIRCRAFT Final Report, Nov. 1975 - Jun. 1976
J. Victor Lebacqz and Edwin W. Aiken Jul. 1976 106 p refs

(Contract N00019-76-C-0225)
(AD-A033618; CALSPAN-AK-5876-F-1) Avail: NTIS HC A06/MF A01 CSCL 01/3

A study program was undertaken to investigate the feasibility of conducting ground- and in-flight simulations of a jet-lift VTOL aircraft performing terminal area operations using the U. S. Navy X-22A V/STOL Research Facility. The objectives of the program were: To develop a generic mathematical model of the AV-8A aircraft during a decelerating approach to hover; To develop the methodology for computing the variable stability gains required to simulate the AV-8A model with the X-22A; and To develop the procedures for implementing the simulation in the X-22A ground simulator. The general conclusion for this study is that it is feasible to simulate in the X-22A aircraft an AV-8A class VTOL aircraft during terminal area operations. The methodology for performing such a simulation is developed, and the techniques for mechanization on the X-22A ground simulator for further experimental investigation are described. Excellent simulation fidelity is possible during low-speed flight equal to or less than 60 kts. Areas which require further investigation include the discrepancies in response to throttle inputs at higher speeds and the necessity for matching lateral acceleration responses at the pilot's station to control inputs. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography*.

N77-22101# Illinois Univ., Urbana-Champaign. Coordinated Science Lab.

CONTROL STRATEGIES FOR COMPLEX SYSTEMS FOR USE IN AEROSPACE AVIONICS Interim Report, 30 Jun. 1975 - 29 Jun. 1976

Jose B. Cruz, Jr. 20 Aug. 1976 14 p refs
(Grant AF-AFOSR-2570-73)
(AD-A032673; AFOSR-76-1155TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

The research program is concerned with the development of concepts and methodology for the analysis and design of control strategies for complex systems for use in aerospace avionics. This report highlights the results obtained during the grant period, which are fully documented in the journal articles, meeting papers, and reports cited in the list of publications. Author (GRA)

N77-22102# Army Missile Research, Development and Engineering Lab., Redstone Arsenal, Ala. Guidance and Control Directorate.

COMPUTER CONTROLLED TARGET LOCATOR/ DESIGNATOR SYSTEM

Little J. Little, Michael C. Pitruzello, Dan T. Reed, and John R. Williams 22 Jul. 1976 54 p refs
(DA Proj. 1M3-62303-A-214)
(AD-A031416; RG-7T-4) Avail: NTIS HC A04/MF A01 CSCL 19/5

This report presents the results of a technology program conducted at the Guidance and Control Directorate, U.S. Army Missile Research, Development and Engineering Laboratory to demonstrate the feasibility of using a digital computer and navigation unit to control an optical sight/laser designator system. The system tested the capability to determine the coordinates of a target visible in the optical sight to cue the optical sight to coordinates furnished by the operator, and to track a target inertially to compensate for aircraft motion. GRA

N77-22103# Dynamics Research Corp., Wilmington, Mass.

MID-1980S DIGITAL AVIONICS INFORMATION SYSTEM CONCEPTUAL DESIGN CONFIGURATION Final Report, May 1975 - Mar. 1976

Andrew J. Czuchry, Herbert E. Engel, Richard Dowd, H. Anthony Baran (Advanced Systems Div., Wright-Patterson AFB, Ohio), Duncan Dieterly (Advanced Systems Div., Wright-Patterson AFB, Ohio), and Ron Greene (Headquarters AF Logistics Command, Wright-Patterson AFB, Ohio) Brooks AFB, Tex. AFHRL Jul. 1976 119 p refs
(Contract F33615-75-C-5218)
(AD-A032137; AFHRL-TR-76-59) Avail: NTIS HC A06/MF A01 CSCL 09/3

The research reported herein is part of a larger research effort entitled Digital Avionics Information System (DAIS) Life Cycle Costing (LCC) Study. The objective of the total effort is to provide USAF with an enhanced in-house capability to incorporate LCC considerations during all stages of the weapon system acquisition process into the following trade-off areas: avionics design, weapon system operation and maintenance, and planning for manpower utilization and training. The initial application of the results of the study will be to assess the LCC impact of the implementation of the DAIS in the mid-1980s Close Air Support (CAS) weapon system. The research reported in this technical report was performed to develop two conceptual design configurations. These demonstrate the application of the DAIS concept of avionics integration in the avionics suites of two CAS weapon systems: one of the present day genre, and one of the mid-1980s time frame. They will serve as the data baseline for the remaining tasks of the DAIS LCC Study. This report presents the two conceptual design configurations representative of a current and a mid-1980s DAIS-configured CAS aircraft avionics suite. They are specified in detail sufficient to support the remaining tasks of the DAIS LCC Study, to include: maintenance task analyses; the development of realistic acquisition, operation, and support costs; and the development of suitable maintenance manpower training techniques and criteria. The report describes in detail the six major subtasks conducted during the development of the conceptual design configuration. GRA

N77-22104# Naval Air Engineering Center, Lakehurst, N.J. Ground Support Equipment Dept.

SUPPORT EQUIPMENT PROGRAM FOR AVIONICS READINESS: INTITIAL PLANNING

John Bauer and Robert Staples 2 Dec. 1976 62 p refs
(WF41461408)
(AD-A033585; NAEC-GSED-104) Avail: NTIS HC A04/MF A01 CSCL 01/5

The Support Equipment Program for Avionics Readiness has been developed to provide greater reliability and improved maintainability of avionics and support equipment than has been achieved thus far. These goals can be achieved by properly developing the necessary technology for incorporating a high degree of readiness into the design of new equipment and for providing the specialized support equipment required to maintain this equipment. In order to attain the high degree of readiness required in future avionics systems, the Support Equipment Program for Avionics Readiness must now be instituted to insure that new technology be included when ready. In order to provide industry with definitive specifications for improved avionics systems, the Navy must have the capacity to define readiness problems and goals, to conduct research in weak or high technological risk areas, and to apply new techniques in systems designs. These efforts must be directed toward both the new primary avionics systems and the secondary support equipment systems, which are a vital part of avionics readiness. Advanced weapons systems are of limited value without the proper advanced support equipment required to maintain them. Proposals to accomplish these tasks for achieving avionics readiness have been incorporated into the Support Equipment Program for Avionics Readiness. The plan includes proposals for the development of management guidelines and techniques for demonstration of equipment support features as part of the primary equipment acceptance criteria and for determining the resulting influence on the cost of future systems. Author (GRA)

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N77-22105*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ANALYSIS OF DYNAMIC INLET DISTORTION APPLIED TO A PARALLEL COMPRESSOR MODEL

Leon M. Wenzel and Ronald J. Blaha Washington May 1977 24 p refs

(NASA-TM-X-3522; E-8979) Avail: NTIS HC A02/MF A01 CSCL 21E

An investigation of surge was conducted by using a parallel compressor model of the J85-13 compressor implement on an analog computer. Surges were initiated by various types of dynamic disturbances in inlet pressure. The compressor model was less sensitive to disturbances of short duration, high frequency, and long duration where the compressor discharge pressure could react. Adding steady distortion to dynamic disturbances reduced the amount of dynamic disturbance required to effect surge. Steady and unsteady distortions combined linearly to reduce surge margin. Author

N77-22106*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DYNAMICS OF HIGH-BYPASS-ENGINE THRUST REVERSAL USING A VARIABLE-PITCH FAN

John W. Schaefer, David R. Sagerser, and Edward G. Stakolich Washington May 1977 35 p refs

(NASA-TM-X-3524; E-9026) Avail: NTIS HC A03/MF A01 CSCL 21E

The test program demonstrated that successful and rapid forward-to reverse-thrust transients can be performed without any significant engine operational limitations for fan blade pitch changes through either feather pitch or flat pitch. For through-feather-pitch operation with a flight inlet, fan stall problems were encountered, and a fan blade overshoot technique was used to establish reverse thrust. Author

N77-22107*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

PRELIMINARY STUDIES OF AUTOIGNITION AND FLASHBACK IN A PREMIXING-PREVAPORIZING FLAME TUBE USING JET-A FUEL AT LEAN EQUIVALENCE RATIOS

Cecil J. Marek, Leonidas C. Papathakos, and Peter W. Verbulecz Washington May 1977 14 p refs

(NASA-TM-X-3526; E-9039) Avail: NTIS HC A02/MF A01 CSCL 21E

Lean equivalence ratios from 0.3 to 0.7 were observed. Combustor inlet air pressures were varied from 0.54 to 2.5 MPa, combustor inlet air temperatures from 550 to 700 K, and reference velocities from 8 to 35 meters per second. Autoignition delay times ranged from 15 to 100 milliseconds and varied inversely with pressure. The Arrhenius activation energy was 41,840 joules per mole. Temperature rise data were obtained in a long premixing-prevaporizing tube at a pressure of 0.56 MPa. Preflame temperature rise data were a function of equivalence ratio, inlet air temperature, and tube residence time. Significant temperature rise occurred above temperatures of 760 K, with autoignition occurring at 775 K for equivalence ratios greater than 0.47. The reactions were similar to cool-flame phenomena. Flashback velocities were measured at temperatures of 610 and 700 K, pressure of 0.56 MPa, and equivalence ratios from 0.6 to 1. Flashback velocities varied from 30 to 65 meters per second. Author

N77-22108# Calspan Corp., Buffalo, N.Y.

INVESTIGATION OF ROTATING STALL PHENOMENA IN AXIAL FLOW COMPRESSORS. VOLUME 1: BASIC STUDIES OF ROTATING STALL Final Report, 1 May 1973-31 May 1976

Gary R. Ludwig, Joseph P. Nenni, and John C. Erickson, Jr. Wright-Patterson AFB, Ohio AFAPL Jun. 1976 209 p refs (Contract F33615-73-C-2046; AF Proj. 3066)

(AD-A031658; CALSPAN-XE-5315-A-12-Vol-1; AFAPL-TR-76-48-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 21/5

This report presents the results of a research program that had two major objectives. The first objective was the development of a prototype rotating stall control system which was tested both on a low speed rig and a J-85-5 engine. The second objective was to perform fundamental studies of the flow mechanisms that produce rotating stall, surge, and noise in axial flow compressors and thereby obtain an understanding of these phenomena that would aid attaining the first objective. The work is reported in three separate volumes. Volume 1 covers the fundamental theoretical and experimental studies of rotating stall; Volume 2 covers the theoretical and experimental studies of discrete-tone aerodynamic noise generation mechanisms in axial flow compressors; and Volume 3 covers the development and testing of a prototype rotating stall control system on both the low speed test rig and the J-85-5 engine. GRA

N77-22109# Calspan Corp., Buffalo, N.Y.

INVESTIGATION OF ROTATING STALL PHENOMENA IN AXIAL FLOW COMPRESSORS. VOLUME 3: DEVELOPMENT OF A ROTATING STALL CONTROL SYSTEM Final Report, 1 May 1973 - 31 May 1976

Gary R. Ludwig and Rudy H. Arendt Wright-Patterson AFB, Ohio AFAPL Jun. 1976 156 p refs

(Contract F33615-73-C-2046; AF Proj. 3066)

(AD-A031659; CALSPAN-XE-5315-A-12-Vol-3; AFAPL-TR-76-48-Vol-3) Avail: NTIS HC A08/MF A01 CSCL 21/5

This report presents the results of a research program that had two major objectives. The first objective was the development of a prototype rotating stall control system which was tested both on a low speed rig and a J-85-5 engine. The second objective was to perform fundamental studies of the flow mechanisms that produce rotating stall, surge, and noise in axial flow compressors and thereby obtain an understanding of these phenomena that would aid attaining the first objective. Volume 3 covers the development and testing of a prototype rotating stall control system on both the low speed test rig and the J-85-5 engine. GRA

N77-22110# Bendix Research Labs., Southfield, Mich.

ACOUSTIC EMISSION INVESTIGATION - HELICOPTER ROTOR SYSTEM Final Report, Apr. 1973 - Dec. 1975

R. M. Rusnak, H. C. Yee, and J. K. Sen (Bell Helicopter Co.) Nov. 1976 109 p refs

(Contract DAAJ02-73-C-0066; DA Proj. 1F1-62205-A-119)

(AD-A033571; RLD-7980; USAAMRDL-TR-76-11) Avail: NTIS HC A06/MF A01 CSCL 01/3

An investigation was carried out to determine the feasibility of detecting fatigue crack initiation and growth in dynamically loaded helicopter rotor systems. This was accomplished by first conducting laboratory tests to determine fatigue emission characteristics, signal attenuation, ambient extraneous noise characteristics, and potential noise discrimination methods. The information procured from the laboratory tests was employed to design and assemble an acoustic emission monitoring system. The utility of this system in detecting fatigue crack initiation and growth was demonstrated during fatigue tests of full-scale blade sections. GRA

N77-22111# Lockheed-Georgia Co., Marietta.

ACOUSTIC EMISSION STRUCTURE-BORNE NOISE MEASUREMENTS ON AIRCRAFT DURING FLIGHT Final Report, 20 May - 20 Nov. 1974

W. W. Lewis, Jr., C. D. Bailey, and W. M. Pless May 1976 91 p refs

(Contract F33657-74-C-0588; AF Proj. 7381)

(AD-A033188; LG74ER0147; AFML-TR-75-185) Avail: NTIS HC A05/MF A01 CSCL 01/3

This joint program between the Lockheed-Georgia Company and the Air Force Materials Laboratory was concerned with measuring the structure-borne noise background in a large aircraft

during four test flights to determine the feasibility from a signal-to-noise standpoint of using acoustic emission techniques to monitor structure during flight. Measurements were made in the frequency range from 0.1 MHz to 2.0 MHz using off-the-shelf acoustic emission transducer and 40-db preamplifiers in conjunction with a Lockheed-designed spectrum analyzer and a pulse code modulation data system. Calibration and flight data were recorded on the flight instrumentation magnetic tape recorder. Transducer and preamplifiers were installed at nine locations on the aircraft including the wing, pylong, main landing gear well, and the empennage. A commercial flaw locator system was also installed to monitor the center wing lower surface during the four flights. The results showed that structure-borne noise can vary considerably over the aircraft structure, and that a suitable acoustic emission signal-to-noise ratio can be achieved at most locations within the frequency range 0.5 MHz to 0.75 MHz, although the noisiest areas may require operation up to 1.0 MHz. Author (GRA)

N77-22112# Advisory Group for Aerospace Research and Development, Paris (France).

VARIABLE GEOMETRY AND MULTICYCLE ENGINES

1976 459 p In ENGLISH; partly in FRENCH Presented at the 48th Meeting of the AGARD Propulsion and Energetics Panel held at the Ecole Nationale Superieure des Tech. Avancees, Paris, 6-9 Sep. 1976

(AGARD-CP-205) Avail: NTIS HC A20/MF A01

A broad variety of cycle investigations are presented along with work on geometry variation of individual engine components. Advanced performance for supersonic conventional takeoff and landing aircraft and VTOL aircraft, high speed turboprops, fuel conservation, low noise, low exhaust emission, and integrated control systems are among the topics discussed. For individual titles, see N77-22113 through N77-22145.

N77-22113# Boeing Co., Seattle, Wash.

OPPORTUNITIES FOR VARIABLE GEOMETRY ENGINES IN MILITARY AIRCRAFT

W. C. Swan, A. D. Welliver, G. W. Klees, and S. G. Kyle *In* AGARD Variable Geometry and Multicycle Eng. 1976 9 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Several concepts for engine development and the apparent opportunities such advancements offer in terms of either vehicle performance or total system cost are discussed. Medium range air to surface attack vehicles and long range supersonic vehicles with high altitude recon/strike capability are included. Author

N77-22114# National Gas Turbine Establishment, Pyestock (England).

SOME ASPECTS OF VARIABLE CYCLE PROPULSION SYSTEMS

F. W. Armstrong and D. R. Eigton *In* AGARD Variable Geometry and Multicycle Eng. 1976 11 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The incentives which encourage the study of variable cycle gas turbine powerplants are considered. Achieving performance gains at off-design running conditions, increasing safety and flexibility by providing greater operating margins, and control of both exhaust emissions and noise are discussed. The gains potentially available in a number of civil and military aircraft applications are outlined together with the resulting requirements for cycle variation and the implications for the configuration of the gas turbine engine itself and its intake and exhaust systems. The substantial component and system design problems posed by advanced variable cycle powerplants are included. Author

N77-22115# Centre d'Essais de Propulseurs, Saclay (France).

PARAMETERS FOR OPTIMIZING ENGINES AS A FUNCTION OF MISSION [PARAMETRES D'OPTIMISATION DES MOTEURS EN FONCTION DE LA MISSION]

J. B. Cocheteux, A. Coursimault, and J.-C. G. Ripell *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Conditions under which the choice of cycle for a military engine is determined are investigated. Although elaborated methods for optimization exist, direct reflection is used as the approach to clarify the problem. Constraints imposed on the choice of cycle in combat aircraft are reviewed, and the advantage of variable geometry is assessed. Hypotheses defining a mission are highly influential. In some cases, the choice of characteristics makes compromise easy; in others, contradictions appear. A number of independent variables, some neither technical nor qualifiable, must be taken into consideration when engines are designed. Transl. by A.R.H.

N77-22116# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).

ADVANCED ENGINE DESIGN CONCEPTS AND THEIR INFLUENCE ON THE PERFORMANCE OF MULTI-ROLE COMBAT AIRCRAFT

H. Grieb and E. Ackermann *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Engine design concepts which combine the advantages of the reheated turbojet with the advantages of the reheated turbofan are considered. Emphasis is placed on the demands placed on the power plant by a multirole weapon system. Variable geometry and the penalty in engine weight and complexity are among the factors discussed. It is shown that the variable cycle engine improves the performance of multirole combat aircraft. Author

N77-22117# Naval Air Propulsion Test Center, Trenton, N.J.

VARIABLE CYCLE ENGINES FOR V/STOL FIGHTERS

John R. Facey and Fred C. Glaser (McDonnell Douglas Corp., St. Louis) *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p ref (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The impact of variable cycle engines on advanced V/STOL multimission fighters was studied. A program description is given along with a summary of results and conclusions drawn from the initial phase of the program. Author

N77-22118# Centre de Villaroche, Moissy (France).

VARIABLE CYCLE AND SUPERSONIC TRANSPORT [CYCLE VARIABLE ET TRANSPORT SUPERSONIQUE]

C. Menioux *In* AGARD Variable Geometry and Multicycle Eng. 1976 11 p (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

An ideal variable cycle engine adapted for supersonic transport at Mach 2 is described. Its principal characteristics are explored from the point of view of cycle, space occupied, and internal structure. Transl. by A.R.H.

N77-22119*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

VARIABLE-CYCLE ENGINES FOR SUPERSONIC CRUISE AIRCRAFT

Edward Willis *In* AGARD Variable Geometry and Multicycle Eng. 1976 18 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Variable cycle engine design concepts studied in terms of performance, economic, and environmental requirements that apply to modern supersonic cruise aircraft are described. The dual impact of design simplification and technology advancements is discussed along with advanced technology requirements in air and noise pollution reduction. J.M.S.

N77-22120# Politecnico di Torino (Italy).

NUMERICAL PREDICTION OF THE UNSTEADY FLOW IN VARIABLE GEOMETRY ENGINES - PRELIMINARY INVESTIGATION

Luca Zannetti and Maurizio Pandolfi *In* AGARD Variable Geometry and Multicycle Eng. 1976 7 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

A numerical method is presented which predicts the unsteady flow, through turbojet engines, due to the variation in time of the geometry of some engine component. The approach is based on the idea of replacing the actual bladings with actuator discs, which deflect the gas stream according to the real geometry. Other surfaces of discontinuity simulate the inlet and the exhaust

of the engine and the combustion chamber. The computation is carried out by integrating in time the hyperbolic partial differential equations which describe the gas motion, with a second order of accuracy integration scheme. Numerical examples show the simulated unsteady flow originated by variation in time of stators stagger angles and of exhaust nozzle area. Author

N77-22121*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASSESSMENT OF VARIABLE-CYCLE ENGINES FOR SUPERSONIC TRANSPORTS
E. Boxer, S. J. Morris, and W. E. Foss, Jr. *In* AGARD Variable Geometry and Multicycle Eng. 1976 19 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Propulsion systems are evaluated in terms of relative aircraft range for a fixed payload and takeoff gross weight with a design cruise Mach number of 2.7. In order to put the performance of these engines in perspective, a comparison of these engines and the former U.S. SST engine is made with an idealized variable cycle engine whose performance at all operating points matches that of an optimized point design cycle within specified limits. Range comparisons are made with and without noise level constraints to determine the influence of noise upon cycle selection. The critical areas requiring new or improved technology for each cycle are delineated. Author

N77-22122# Rolls-Royce Ltd., Derby (England).
USE OF ENGINE VARIABLES TO IMPROVE MILITARY PERFORMANCE
N. G. Hatton and B. Swann *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Variation of engine cycle by geometric changes to allow operation nearer the design point is discussed for a variety of flight conditions. The effect of representative losses due to cycle and geometric changes is illustrated. Author

N77-22123# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
POSSIBILITIES OF ADAPTING BY-PASS-ENGINES TO THE REQUIREMENTS OF HIGHER SUPERSONIC FLIGHT
H. Kuenkler *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Methods of improving the adaptability of the reheated bypass engine to supersonic flight missions by varying the thermodynamic cycle are investigated. In particular, the following possibilities were studied: (1) fuel-rich primary-flow heating during reheat operation; (2) fuel-rich total-flow reheating during high-thrust mission segments; (3) precooling of turbine coolant by heat exchange with reheat fuel; and (4) intercooling of primary air flow by heat exchange with reheat fuel. Author

N77-22124# Naval Air Propulsion Test Center, Trenton, N.J.
AUGMENTED DEFLECTOR EXHAUST NOZZLE (ADEN) DESIGN FOR HIGH PERFORMANCE FIGHTERS
J. Lawrence Palcza *In* AGARD Variable Geometry and Multicycle Eng. 1976 7 p (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

A two dimensional augmented deflector exhaust nozzle (ADEN) was designed, fabricated, and tested for use on future advanced multimission V/STOL aircraft. The aerodynamic and mechanical features of the ADEN and the full scale demonstrator program are described. Author

N77-22125# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
VARIABLE CYCLE ENGINE APPLICATIONS AND CONSTRAINTS
Robert J. Payzer *In* AGARD Variable Geometry and Multicycle Eng. 1976 13 p (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

The potential applications for variable cycle engines are discussed along with the payoffs for variable cycle engines and the constraints on these engines both from a totally installed aspect, as well as the internal engine restrictions. Author

N77-22126# United Technologies Corp., East Hartford, Conn.
HIGH EFFICIENCY ENGINE CYCLES FOR AIR TRANSPORT FUEL ECONOMY
D. E. Gray *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

The effects of projected gas turbine technological progress, unconventional thermodynamic processes, and advanced propulsion devices are assessed in terms of their fuel savings potential. The operating characteristics of two selected propulsion systems - an advanced turbofan and a turboprop engine - are projected and compared at points along a transport flight profile. The applicability of engine component geometry variation to improve propulsion system efficiency is also reviewed. Author

N77-22127# Hamilton Standard, Windsor Locks, Conn.
MULTI-MISSION USES FOR PROP-FAN PROPULSION
A. H. Jackson and B. S. Gatzen *In* AGARD Variable Geometry and Multicycle Eng. 1976 12 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Advanced turboprops or Prop-Fans are considered in terms of major reductions in fuel consumption. Aerodynamics, noise reduction, and structural design are discussed along with engine design and applications. J.M.S.

N77-22128# Rolls-Royce Ltd., Bristol (England). Aero Div.
VARIABLE GEOMETRY IN THE GAS TURBINE - THE VARIABLE PITCH FAN ENGINE
R. M. Denning *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

A specific example of a variable pitch engine, the M45SD-02, is examined. Wide speed range, high relative takeoff thrust, low noise, steep approach path control, fuel efficiency, and reverse thrust capability are among the characteristics discussed. Potential applications for the variable pitch engine are included. J.M.S.

N77-22129# Societe Turbomeca, Bordes (France).
THE ASTAFAN: DUAL FLOW WITH VARIABLE PITCH AND CONSTANT SPEED [l'ASTAFAN: DOUBLE-FLUX A PAS VARIABLE ET VITESSE CONSTANTE]
Joseph Szydlowski *In* AGARD Variable Geometry and Multicycle Eng. 1976 5 p In FRENCH; ENGLISH summary (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

The historical background of the different variable geometry turbofan engines with constant speed operation is discussed. The present formula includes a fan whose rotating blades have a variable pitch, thus permitting a correct adaptation to the different flight configurations. Author

N77-22130# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany). Aircraft Div.
THE INTERMITTENT JET FOR SUPERSONIC CONDITIONS INCREASED WITH PASSAGE TO OPERATING IN A RAMJET - A LOW COST ENGINE [LE PULSO-REACTEUR POUR REGIME SUBSONIQUE ELEVE AVEC PASSAGE AU FONCTIONNEMENT EN STATO-REACTEUR - UN MOTEUR DE FAIBLE PRIX DE REVIENT]
W. K. Eick *In* AGARD Variable Geometry and Multicycle Eng. 1976 27 p refs In FRENCH (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

The results of preliminary studies made on a jet engine without a safety-valve are reported. Essential parameters were studied in detail to determine their influence on thrust characteristics and fuel consumption. Transl. by B.B.

N77-22131# Pisa Univ. (Italy).
PERFORMANCE CHARACTERISTICS OF TURBO-ROCKETS AND TURBO-RAMJETS USING HIGH ENERGY FUEL
Dino Dini *In* AGARD Variable Geometry and Multicycle Eng. 1976 30 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The aerodynamic and thermodynamic behavior of turborockets and turboramjets is considered. By means of variable engine geometry, multicycle engines meet aircraft requirements for takeoff, climb, cruise, maneuver, loiter, and landing. Performance characteristics are evaluated for these conditions, taking into account variable geometry in some intake and exhaust configurations. Problems arising from future high energy fuels, particularly hydrogen, impose changes in interface components, geometry, and control. Preliminary designs of turborockets and turboramjets for military and civil applications are discussed. Author

N77-22132# Naples Univ. (Italy).

RAM-TURBOJET ENGINE FOR LONG RANGE HIGH TERMINAL SPEED MISSIONS

Rodolfo Monti and Attilio Galasso (AERITALIA, Naples, Italy) *In* AGARD Variable Geometry and Multicycle Eng. 1976 14 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Preliminary calculations are presented for a combined ramjet-turbofan engine where the long range, low speed, low altitude flight is powered by the turbofan, and the final supersonic approach at low altitude is powered by the ramjet after the turbofan has been jettisoned. The system is evaluated, and possible competitive solutions are compared. Design criteria are also discussed, and an applicative example is presented. Author

N77-22133# Army Air Mobility Research and Development Lab., Fort Eustis, Va. Technology Applications Div.

CONVERTIBLE FAN SHAFT ENGINE (FOR ROTARY WING AIRCRAFT)

John W. White *In* AGARD Variable Geometry and Multicycle Eng. 1976 15 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The convertible fan shaft (CFS) engine, utilizing lightweight fan and advanced turboshaft engine technology, is proposed as a propulsion system for a compound helicopter that can potentially double the operating envelope of present rotary wing aircraft. The compound helicopter's performance capabilities and propulsion requirements are briefly reviewed. The AH-56 Cheyenne aircraft is used as a baseline to evaluate the CFS engine. Author

N77-22134# Cranfield Inst. of Technology (England). School of Mechanical Engineering.

AN APPLICATION FOR VARIABLE INLET GUIDE VANES IN DISTORTION SUPPRESSION

R. E. Peacock and M. A. R. A. El-Attar *In* AGARD Variable Geometry and Multicycle Eng. 1976 16 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The effects of distortion upon compressor performance are considered, and a design technique for inlet guide vanes to decrease the effect of circumferential pressure distortion is discussed. A method of selectively varying the stagger of a sector of the guide vane row to minimize the effect of change of rotor incidence created by circumferential distortion is analyzed. Design charts for both cases are included. Author

N77-22135# Rolls-Royce Ltd., Bristol (England). Aero-Div.

THE PREDICTION AND OPTIMISATION OF VARIABLE GEOMETRY STATORS FROM COMPRESSOR BASIC DATA

P. A. Whiteman *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p ref (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

With high performance axial flow compressors, there is a positive requirement for variable geometry. The amount of variable geometry required in terms of the number of variable stators rows, the stator travel, and rate of travel are all important parameters. The effects of these parameters on compressor performance can be predicted and optimized using the stage stacking method of analysis. Author

N77-22136# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).

PREDICTION OF VARIABLE GEOMETRY COMPRESSOR PERFORMANCES (OFF DESIGN)

Pierre Bry and Yves LeBot *In* AGARD Variable Geometry and Multicycle Eng. 1976 7 p refs In FRENCH; ENGLISH summary (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The effect of variable geometry on compressor performance was investigated numerically. This approach, based on a simplified way of writing derivatives with respect to the axial direction, allows the calculation of trough flow (uniform tangentially) in subsonic, transonic, and supersonic regimes, provided no shock waves occur in the calculation planes. The overall flow analysis takes into account losses caused by fluid friction, wake mixing, angle of attack, and cross section variation. Results are compared to experimental data obtained on a low speed compressor with variable blade angle settings. Author

N77-22137# Societe Nationale d'Etudes et de Construction de Moteurs d'Aviation, Moissy-Cramayel (France).

ANTI-NOx COMBUSTION CHAMBER WITH VARIABLE AERODYNAMIC FLOW FOR A TURBO-JET ENGINE [CHAMBRE DE COMBUSTION ANTI-NOx A ECOULEMENT AERODYNAMIQUE VARIABLE POUR TURBOREACTEUR]

Ph. Gastebois and J. Caruel *In* AGARD Variable Geometry and Multicycle Eng. 1976 11 p In FRENCH (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The work of the SNECMA on reducing the NO(2) emissions produced by the combustion chambers of turbojet engines is discussed in detail, and the plan for a chamber with two modules is presented. Experimental results are also included.

Transl. by B.B.

N77-22138# Laval Univ. (Quebec).

DESIGN FEATURES FOR A PRE-MIXED VARIABLE AREA COMBUSTOR

J. Odgers and D. Kretachmer *In* AGARD Variable Geometry and Multicycle Eng. 1976 7 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Design features of a premixed variable area combustor for pollution control are analyzed, especially with respect to the construction of the primary zone and its ancillary parts. In addition, the practicability of the control of the three major pollutants, oxides of nitrogen, carbon monoxide, and unburnt hydrocarbons, is discussed. Author

N77-22139# Cranfield Inst. of Technology (England). School of Mechanical Engineering.

THE VARIABLE GEOMETRY COMBUSTOR

R. S. Fletcher and R. C. Adkins *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

The concept of variable geometry as it applies to the control of emissions from gas turbine combustors and potential of a novel fluidic device to put the concept into practice are reviewed. This method is based upon the use of a bled vortex generated to control and vary the air distribution characteristics within the combustor liner. Experimental data are given from the first 'cold' tests carried out with the device. It was concluded that although significant emission reductions can be achieved by the use of variable geometry, it is unlikely that the level of reduction attained will be sufficient to exceed the appropriate U.S. Federal Standards for civil aircraft engines. Results also indicate that the vortex controlled, variable geometry combustor has potential for further development. Author

N77-22140# Technische Hochschule, Munich (West Germany). Aerospace Inst.

THE PROS AND CONS OF VARIABLE GEOMETRY TURBINES

H. G. Muenzberg and J. Kurzke *In* AGARD Variable Geometry and Multicycle Eng. 1976 12 p ref (For primary document see N77-22112 13-07)

Avail: NTIS HC A20/MF A01

Analysis of the advantages of variable geometry turbines indicates that an adjustable stator in the low pressure of a two spool turbojet is of no explicit advantage. The shape of the

compressor performance map could be so altered that, even in a simple example, a stator adjustment would result in an improvement of fuel consumption. In this case, stator adjustment proves to be advantageous. Such a result cannot be considered as generally valid, because only the characteristic of one specific engine can be altered, and then only in the form of a remedial measure. Variable geometry can be advantageous for flight missions in which the engine is run for long periods of time at a very low partial load. Author

N77-22141# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
POTENTIAL IMPROVEMENTS IN ENGINE PERFORMANCE USING A VARIABLE GEOMETRY TURBINE
Robert J. May, Jr., Wayne A. Tall, and H. Ivan Bush *In* AGARD Variable Geometry and Multicycle Eng. 1976 16 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Installed performance characteristics of a fixed geometry turbofan, a fixed geometry turbojet, and a variable geometry turbojet are compared for typical subsonic cruise, supersonic cruise and combat flight conditions. Results indicate that for applications where both subsonic and supersonic fuel consumptions are important, a variable geometry turbine turbojet can offer substantial reductions in fuel usage. Author

N77-22142# Rolls-Royce Ltd., Bristol (England). Bristol Engine Group.
VARIABLE FLOW TURBINES
R. J. Latimer *In* AGARD Variable Geometry and Multicycle Eng. 1976 6 p (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Varying turbine flow capacity by restaggering the stator blades or by restricting the annulus is considered. A brief survey of research into controlling the turbine flow is given along with conclusions. J.M.S.

N77-22143# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
EXPERIENCE WITH A ONE STAGE VARIABLE GEOMETRY AXIAL TURBINE
J. Hourmouziadis, K. Hagemeister, O. Rademacher, and H. Kolben *In* AGARD Variable Geometry and Multicycle Eng. 1976 9 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

Based on steady-state and transient performance characteristics of a two spool turboshaft engine, the possible improvements resulting from a variable geometry power turbine are discussed and the design requirements defined. The aerodynamic design of a turbine fulfilling these requirements is described, and the predicted power turbine characteristic is presented and compared with component test results. The design and development of the hot environment variable stator mechanism is described, including consideration of the vane positioning accuracy and response characteristics. Performance test results and the problems encountered with the turbine operating in a full scale engine are presented. Mechanical aspects such as the long term endurance capability of the variable stator mechanism, as well as vibrational problems of the rotor blading caused by the variable geometry, are discussed. Author

N77-22144# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
INTEGRATED PROPULSION CONTROL SYSTEM FOR FIGHTER AIRCRAFT
Joseph J. Batka *In* AGARD Variable Geometry and Multicycle Eng. 1976 10 p refs (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

An integrated propulsion control system (IPCS) was designed, fabricated, and flight tested on a F-111 aircraft. The IPCS combined the functions of the traditionally separate inlet and engine controls into one computational unit. This integrated approach was proven to be a most effective way to utilize the full potential of the propulsion components to achieve a high performance aircraft. Author

N77-22145# British Aircraft Corp. (Operating) Ltd., Bristol (England). Electronics and Space Systems Group.
THE BENEFITS OF AN INTEGRATED DIGITAL POWER-PLANT CONTROL SYSTEM
R. S. Dale Afima *In* AGARD Variable Geometry and Multicycle Eng. 1976 11 p (For primary document see N77-22112 13-07)
Avail: NTIS HC A20/MF A01

The flight experience gained on air intake control was applied to a study of the feasibility of integrating the controls of a powerplant (air intake, engine, reheat, and nozzles) into a single digital system. The control system developed and the benefits and problems of integration are described. Author

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N77-22146*# Boeing Co., Wichita, Kans.
SCAR ARROW-WING ACTIVE FLUTTER SUPPRESSION SYSTEM Final Report, Jan. - Dec. 1976
C. K. Gordon and O. E. Visor Apr. 1977 137 p refs
(Contract NAS1-14205)
(NASA-CR-145147; D3-11139-1) Avail: NTIS HC A07/MF A01 CSCL 01C

The potential performance and direct operating cost benefits of an active flutter suppression system (FSS) for the NASA arrow-wing supersonic cruise configuration were determined. A FSS designed to increase the flutter speed of the baseline airplane 20 percent. A comparison was made of the performance and direct operating cost between the FSS equipped aircraft and a previously defined configuration with structural modifications to provide the same flutter speed. Control system synthesis and evaluation indicated that a FSS could provide the increase in flutter speed without degrading airplane reliability, safety, handling qualities, or ride quality, and without increasing repeated loads or hydraulic and electrical power capacity requirements. Author

N77-22147*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THRUST AUGMENTED SPIN RECOVERY DEVICE Patent Application
Bobby L. Berrier, inventor (to NASA) Filed 28 Sep. 1976 14 p
(NASA-Case-LAR-11970-1; US-Patent-Appl-SN-727503) Avail: NTIS HC A02/MF A01 CSCL 01C

Yaw control surfaces are provided for a jet propelled aircraft wherein a thrust augmented rudder is disposed above the jet exhaust stream. A thrust rudder tab extends downward into the jet exhaust stream with these components being cooperatively deflected to generate yawing moments for directional control of the aircraft. NASA

N77-22148# Rockwell International Corp., Columbus, Ohio. Columbus Aircraft Div.
DESIGN AND TEST OF AN LHS LATERAL CONTROL SYSTEM FOR A T-2C AIRPLANE Final Report, 1 Jul. 1975 - 6 May 1976
Joseph N. Demarchi and Robert K. Haning May 1976 102 p refs
(Contract N62269-75-C-0422)
(AD-A032677; NR76H-14; NADC-76166-30) Avail: NTIS HC A06/MF A01 CSCL 01/3

An 8000 psi hydraulic lateral control system was designed and tested for future evaluation in a T-2C airplane. Analyses were performed to estimate hydraulic fluid temperatures and pump suction line pressurization during flight. Laboratory tests were conducted to determine fluid temperatures, pressure surges, stability, and endurance. The tests demonstrated the system is satisfactory for progressing into the flight evaluation phase of the program. Author (GRA)

N77-22809*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

APPLICATION OF ACTIVE CONTROLS TO CIVIL TRANSPORT AIRCRAFT
Lawrence W. Taylor, Jr. *In its* Systems Reliability Issues for Future Aircraft 1975 p 9-20 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

N77-22810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AMES ACTIVE CONTROL AIRCRAFT FLIGHT EXPERIMENTS (ACA) PROGRAM
George Meyer and William R. Wehrend *In its* Systems Reliability Issues for Future Aircraft 1975 p 21-26 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

N77-22811*# Honeywell, Inc., Minneapolis, Minn.
ADAPTIVE CONTROL LAWS FOR F-8 FLIGHT TESTS
G. Stein, G. L. Hartmann, and R. C. Hendrick *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 27-49 refs (For primary document see N77-22808 13-59) (Contracts NAS1-12680; NAS1-13383)
Avail: NTIS HC A10/MF A01 CSCL 01D

N77-22813*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FAILURE DETECTION AND CONTROL-SYSTEM RECONFIGURATION: PAST, PRESENT, AND FUTURE
Raymond C. Montgomery *In its* Systems Reliability Issues for Future Aircraft 1975 p 69-78 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N77-22149# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
MODEL USERS MANUAL FOR AIRFIELD CAPACITY AND DELAY MODELS, BOOK 2 Final Report
Carl T. Ball Nov. 1976 172 p
(FAA Proj. 082-421-214)
(AD-A036354; FAA-RD-76-128-Bk-2) Avail: NTIS HC A08/MF A01 CSCL 01/5

Examples are given for the Delay Simulation Model. Author

N77-22150# Army Construction Engineering Research Lab., Champaign, Ill.
TECHNICAL BACKGROUND: INTERIM CRITERIA FOR PLANNING ROTARY-WING AIRCRAFT TRAFFIC PATTERNS, AND SITING NOISE-SENSITIVE LAND USES Interim Report
P. D. Schomer and B. L. Homans Sep. 1976 20 p refs
(DA Proj. 4A7-62720-A-896)
(AD-A031449; CERL-IR-N-9) Avail: NTIS HC A02/MF A01 CSCL 01/3

This report presents interim criteria for locating rotary-wing aircraft traffic patterns and ingress and egress corridors into an airfield/heliport to avoid conflict with noise-sensitive land uses, and provides criteria for planners to site noise-sensitive land uses with respect to the established airfield/heliport and established flight corridors. These interim criteria are required because the exact Air Force technique for predicting fixed-wing aircraft noise cannot currently be used due to the unpredictability of helicopter flight patterns; these criteria are the basis for interim procedures established in a companion report, User Manual: Interim Procedure for Planning Rotary-Wing Aircraft Traffic Patterns and Siting Noise-Sensitive Land Uses (Construction Engineering Research Laboratory Interim Report N-10, 1976). Author (GRA)

N77-22151# Army Construction Engineering Research Lab., Champaign, Ill.
USER MANUAL: INTERIM PROCEDURE FOR PLANNING ROTARY-WING AIRCRAFT TRAFFIC PATTERNS AND SITING NOISE-SENSITIVE LAND USES Interim Report
P. D. Schomer and B. L. Homans Sep. 1976 41 p
(DA Proj. 4A7-62720-A-896)
(AD-A031450; CERL-IR-N-10) Avail: NTIS HC A03/MF A01 CSCL 01/3

This report presents: (1) interim procedures for determining the location of rotary-wing aircraft traffic patterns and ingress and egress corridors into an airfield/heliport area to avoid conflict with noise-sensitive land uses, and (2) criteria for siting noise-sensitive land uses with respect to established airfield or heliport plans. The procedures are based on interim criteria established in a companion report, Technical Background: Interim Criteria for Planning Rotary-Wing Aircraft Traffic Patterns and Siting Noise-Sensitive Land Uses (Construction Engineering Research Laboratory Interim Report N-9 1976). The presentation of the procedures includes a history of noise impact measures, a background of the development of noise contours, and tables for finding the noise impact. A complete descriptive example of the use of the procedures is presented as an aid to the reader. Author (GRA)

N77-22152# Spectron Development Labs., Inc., Costa Mesa, Calif.
ENVIRONMENTAL CHARACTERISTICS AND EXPERIMENTAL LIMITATIONS OF ARC-HEATED REENTRY TEST FACILITIES Interim Report
A. T. Wassel and J. F. Courtney Jun. 1976 104 p refs
(Contract F44620-76-C-0011; AF Proj. 9781)
(AD-A031285; SDL-76-6048; AFOSR-76-1097TR) Avail: NTIS HC A06/MF A01 CSCL 14/2

A critical examination of the nature of the flows in arc-heated jet facilities, and the several uses that these facilities are put to is presented. Conclusions as to the applicability and validity of these tests for various re-entry problems are drawn and recommendations are presented for improved calibrations of existing facilities and/or new features required for next generation facilities. GRA

N77-22153# New Mexico State Univ., University Park. Physical Science Lab.
SOUNDING ROCKET AND BALLOON SYSTEMS SUPPORT Final Report, 1 May 1973 - 31 Jul. 1976
Raymond A. Bumgarner and Arthur A. Gilcrease 13 Sep. 1976 10 p
(Contract F19628-73-C-0240)
(AD-A032308; PSL-PS-00855; AFGL-TR-76-0228) Avail: NTIS HC A02/MF A01 CSCL 19/7

The work performed under this contract consisted of the following; integrate, calibrate, and test, GFE range safety radar tracking beacon and parachute recovery systems; design and develop special devices as required; operate and maintain GFE telemetry station to support telemetry operations at WSMR, New Mexico; and calibrate equipment and perform analyses for air sampling balloon flights conducted at Holloman AFB, New Mexico. Author (GRA)

N77-22154# Naval Civil Engineering Lab., Port Hueneme, Calif.
EFFECTS OF PAVEMENT ROUGHNESS ON NAVAL AIR OPERATIONS Final Report, Apr. - Dec. 1974
John M. Ferritto and James B. Forrest Aug. 1976 24 p refs
(AD-A033558; CEL-TR-846) Avail: NTIS HC A02/MF A01 CSCL 01/5

A review of the problem of airfield roughness has been made. Either as a result of bad construction methods or, more generally, gradual deterioration, variations that impair the performance of aircraft during ground operations may occur in pavement surface elevations. Although no general standards for evaluating roughness have been accepted, use of the level of 0.4 g maximum peak vertical acceleration response of aircraft in ground operational mode is recommended. A computer program using aircraft characteristics and runway profile is described for

use in evaluating the Navy's problems in Roughness. Rough pavements do not appear to be a widespread problem for Naval air operations. However, several problem areas are noted. Specific repair may be evaluated using the computer program. It is not presently recommended that the roughness evaluation procedures be incorporated into runway condition surveys. Author (GRA)

N77-22155# Illinois Univ., Urbana-Champaign. Savoy Aviation Research Lab.
DESIGN OF A DIGITAL AIRCRAFT SIMULATOR FOR USE WITH A COMPUTER-AIDED DECISION MAKER M.S. Thesis. Final Report
Paul Dennis Biolchini 1976 83 p refs
(Contract F33615-73-C-1238)
(AD-A033506; ARL-76-19/AFAL-76-1) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report summarizes the work done on a study titled Computer-Aided Decision Making for Flight Operations conducted by the University of Illinois under Air Force Contract F33615-73-C- 1238. The report describes in detail the development of equations of motions, simulated flight costs, and the results of the flight tests for a simplified computer model of a twin jet aircraft. Author (GRA)

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N77-22156*# Rice Univ., Houston, Tex.
THERMODYNAMIC PROPERTY DETERMINATION IN LOW GRAVITY Final Report
John L. Margrave 31 Jan. 1977 35 p refs
(Contract NAS8-32030)
(NASA-CR-150239) Avail: NTIS HC A03/MF A01 CSCL 22A

Techniques for determining heat capacities and other properties of molten metals were investigated and critically evaluated. Precisely determining heat capacities calorimetrically in space poses several problems. The weight of a drop calorimeter block along with the necessity of obtaining a large number of data points tend to make traditional approaches appear infeasible. However, for many substances exhibiting sufficiently high thermal conductivities and with known emissivities, it appears possible to investigate their properties by observing the rate of cooling of a levitated sphere which is initially at a uniform temperature above the melting point. A special advantage of the levitation method is that considerable supercooling is expected, making the study of the heat capacities of molten metals both above and below their melting points possible. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N77-22157*# Cornell Univ., Ithaca, N.Y. Coll. of Engineering.
CONTROL ELEMENTS FOR AN UNMANNED MARTIAN ROVING VEHICLE Final Report, 1 Sep. 1974 - 31 Aug. 1975
R. L. Wehe and R. E. Osborn 31 Dec. 1976 50 p
(Contract NASw-2750)
(NASA-CR-152836; MRV-75-1) Avail: NTIS HC A03/MF A01 CSCL 13F

The roving vehicle simulator was operated autonomously under control of the simulated on-board computer. With the microwave radar obstacle sensor mounted and operating, it was able to avoid a student placed in its path and to return to the originally assigned direction when that path was clear. The tactile obstacle sensor was able to detect impassable obstacles while allowing the vehicle to negotiate passable obstacles. Author

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N77-22158# Royal Military Coll. of Canada, Kingston (Ontario).
ATTITUDE CONTROL OF A SATELLITE WITH MEDIUM SIZE FLEXIBLE SOLAR ARRAYS
J. B. Plant and R. K. Maxwell 22 Feb. 1977 46 p refs
Backup document for AIAA synoptic scheduled for publication in Journal of Spacecraft and Rockets in Sep. 1977
(Grant DRB-G-4003-06)
Avail: NTIS HC A03/MF A01

A controller is designed for a momentum wheel stabilized communications satellite with medium-sized flexible solar arrays. The design is applied to CTS; this satellite uses hydrazine thrusters in both roll and yaw and only the roll motion is monitored. State variable and observer theory are used and the design relies on a transformation to the Jordan canonical state space. Simulations promise good performance in spite of: solar array flexure and angular position changes, output measurement noise, solar wind variations, and thruster degradation. Author

N77-22159*# Northrop Services, Inc., Huntsville, Ala.
RECOVERY OF SPINNING SATELLITES Final Report
J. M. Coppey and W. R. Mahaffey Mar. 1977 105 p refs
(Contract NAS8-29627)
(NASA-CR-150245; TR-224-1777) Avail: NTIS HC A06/MF A01 CSCL 22A

The behavior of a space tug and a spinning satellite in a coupled configuration was simulated and analyzed. A docking concept was developed to investigate the requirements pertaining to the design of a docking interface. Sensing techniques and control requirements for the chase vehicle were studied to assess the feasibility of an automatic docking. The effects of nutation dampers and liquid propellant slosh motion upon the docking transient were investigated. Author

N77-22160# Wentworth Inst., Boston, Mass.
PAYLOAD INSTRUMENTATION FOR PROBING ROCKETS Final Report, 1 Apr. 1973 - 31 Mar. 1976
Martin J. Davin Hanscom AFB, Mass. AFGL 3 Apr. 1976 18 p
(Contract F19628-73-C-0232; AF Proj. 7659)
(AD-A031311; AFGL-TR-76-0163) Avail: NTIS HC A02/MF A01 CSCL 19/7

This report summarizes the services supplied in support of the sounding rocket research program of the Air Force Geophysics Laboratory. Author (GRA)

N77-22161# National Environmental Satellite Service, Washington, D. C. Office of System Engineering.
THE GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITES (GOES) DATA COLLECTION SYSTEM PLATFORM ADDRESS CODE
Wilfred E. Maxur, Jr. Oct. 1976 33 p refs
(PB-261968/2; NOAA-TM-NESS-82; NOAA-76111035) Avail: NTIS HC A03/MF A01 CSCL 09D

The theory and implementation methods involved with Data

Collection Platform addressing are described. The GOES Data Collection System (GOES-DCS) is designed to collect a large variety of environmental data from virtually any location in the Western Hemisphere. The system is a data relay network consisting of thousands of individual data-gathering devices (or platforms) which transmit their data to one of two Geostationary Operational Environmental Satellites (GOES). These platforms transmit their data in response to an interrogation or poll originating from a Command and Data Acquisition (CDA) Station located in Wallops Station, Virginia. GRA

N77-22162# RDP, Inc., Waltham, Mass.
ATMOSPHERE EXPLORER MESA ACCELEROMETER DATA PROCESSING SYSTEM Final Report, 15 Jan. 1973 - 15 Jan. 1976
Robert W. Fioretti, ed., Alfred J. Bird, Jacobus D. DeClercq Zubli, John P. Fasano, Walter G. Faxon, Robert W. Floretti, Jules Gilbert, Joseph P. Noonan, and Susan M. Ruggles 15 Feb. 1976 56 p refs
(Contract F19628-73-C-0142)
(AD-A033002; AFGL-TR-76-0137) Avail: NTIS HC A04/MF A01 CSCL 04/1

This report summarizes the data processing required to systematically extract scientifically meaningful data from the accelerometer experiment flown aboard the Atmosphere Explorer series of satellites. Many of the results given will be incorporated by analysts and experimenters into presentations given at scientific meetings. Author (GRA)

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation*.

N77-22163*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ON-ORBIT CHECKOUT STUDY Final Report, 1 Oct. 1975 - 30 Jun. 1976
Ernest I. Pritchard 13 Jan. 1977 100 p refs
(Contract NASw-2884)
(NASA-CR-152682; ATR-76(7372-01)-1) Avail: NTIS HC A05/MF A01 CSCL 22A

The spaceborne testing equipment carried by the orbiter and the measuring equipment onboard the satellite (telemetry) is tested to verify that each is operating satisfactorily. The satellite command system is also checked. Thermal stabilization with the satellite in the orbiter shadow is achieved in six to eight hours. Satellite subsystem tests are run, and thermal control by heaters is checked. Thermal stabilization with the satellite exposed to the sun (when the orbiter is in sunlight) is again achieved in an estimated six to eight hours. Subsystem tests are again run in the hot condition, and heat rejection tests are made. Author

N77-22164*# General Electric Co., Philadelphia, Pa. Space Div.
VIBROACOUSTIC TEST PLAN EVALUATION: PARAMETER VARIATION STUDY
C. V. Stahle and H. R. Gongloef 31 Dec. 1976 96 p refs
(Contract NAS5-20906)
(NASA-CR-152487; DOC-76SDS4285) Avail: NTIS HC A05/MF A01 CSCL 22B

Statistical decision models are shown to provide a viable method of evaluating the cost effectiveness of alternate vibroacoustic test plans and the associated test levels. The methodology developed provides a major step toward the development of a realistic tool to quantitatively tailor test programs to specific payloads. Testing is considered at the no test, component, subassembly, or system level of assembly. Component redundnancy and partial loss of flight data are considered. Most and probabilistic costs are considered, and incipient failures resulting from ground tests are treated. Optimums defining both component and assembly test levels are indicated for the modified test plans considered. modeling simplifications must be considered in interpreting the results relative to a particular payload. New parameters introduced were a no test option, flight by flight failure probabilities, and a cost to design components for higher vibration requirements. Parameters varied were the shuttle payload bay internal acoustic environment, the STS launch cost, the component retest/repair cost, and the amount of redundancy in the housekeeping section of the payload reliability model. Author

N77-22165*# General Electric Co., Philadelphia, Pa. Space Div.
FEASIBILITY AND SYSTEMS DEFINITION STUDY FOR MICROWAVE MULTI-APPLICATION PAYLOAD (MMAP) Interim Report, Sep. 1976 - Mar. 1977
J. B. Horton, C. C. Allen, M. J. Massaro, J. L. Zemany, J. W. Murrell, R. W. Stanhouse, G. P. Condon, and R. F. Stone Mar. 1977 149 p refs
(Contract NAS5-23734)
(NASA-CR-152493; Doc-77SDS4220) Avail: NTIS HC A07/MF A01 CSCL 22A

There were three Shuttle/Spacelab experiments: adaptive multibeam phased array antenna (AMPA) experiment, electromagnetic environment experiment (EEE), and millimeter wave communications experiment (MWCE). Work on the AMPA experiment was completed. Results included are definition of operating modes, sequence of operation, radii of operation about several ground stations, signal format, foot prints of typical orbits and preliminary definition of ground and user terminals. Definition of the MOD I EEE included conceptual hardware designs, spacelab interfaces, preliminary data handling methods, experiment tests and verification, and EMC studies. The MWCE was defined conceptually for a steerable high gain antenna. Author

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications*.

N77-22166# Denver Univ., Colo.
BALLOON-BORNE PCM TELEMETRY AND COMMAND SYSTEM
David G. Murcray, James N. Brooks, John VanAllen, Dale Steffen, and Robert C. Amme 29 Oct. 1976 16 p
(Grant DAAG29-76-G-0113)
(AD-A032072; ARO-13816.1-GS) Avail: NTIS HC A02/MF A01 CSCL 09/6

A balloon-borne command and data handling PCM telemetry system suitable for use with complex payloads is described. While the unit was designed for a particular payload, care was used throughout the design to make the system easily adaptable to other balloon-borne instruments. GRA

N77-22167# Naval Weapons Center, China Lake, Calif. Range Dept.
TRANSMISSION OF TELEMETRY DATA BY EXISTING TELEVISION SYSTEMS
James L. Rieger Oct. 1976 35 p refs
(ZF61512001)
(AD-A033294; NWC-TP-5837) Avail: NTIS HC A03/MF A01 CSCL 09/6

By encoding an existing TV system in which the signal contains predictable patterns or redundancy, each of which implies that less than an available bandwidth is being used, it is possible to transmit telemetry data and video simultaneously. A nearly orthogonal system could be inserted into blank portions of an existing black-and-white or color video presentation. Theoretically at least, the added data stream should not affect the existing picture, nor should the existing picture interfere with the added data stream. A demonstration model is described that was designed to measure the effects of adding piggyback data to an existing video system to evaluate results by comparison with known data signals and for subjective evaluation of the resulting

picture. The report covers characteristics of black-and-white and color TV systems; determinations on what additional data could be transmitted without interference; and descriptions of a modulator-demodulator, a carrier generator, and other hardware designed to test the concept. GRA

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support*. For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics*.

N77-22168*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

THE ROLE OF FRACTURE MECHANICS IN THE DESIGN OF FUEL TANKS IN SPACE VEHICLES

Stephen J. Denton and C. K. Liu (Alabama Univ., University) Dec. 1976 50 p refs

(NASA-TM-X-73371) Avail: NTIS HC A03/MF A01 CSCL 22A

With special reference to design of fuel tanks in space vehicles, the principles of fracture mechanics are reviewed. An approximate but extremely simple relationship is derived among the operating stress level, the length of crack, and the number of cycles of failure. Any one of the variables can be computed approximately from the knowledge of the other two, if the loading schedule (mission of the tank) is not greatly altered. Two sample examples illustrating the procedures of determining the allowable safe operating stress corresponding to a set of assumed loading schedule are included. The selection of sample examples is limited by the relatively meager available data on the candidate material for various stress ratios in the cycling. Author

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography*.

N77-22169*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

CONCEPTUAL DESIGN OF AN ON-BOARD OPTICAL PROCESSOR WITH COMPONENTS Final Report, 9 Jan. 1976 - 9 Jan. 1977

J. R. Walsh and R. G. Shackelford 9 Jan. 1977 65 p refs (Contract NAS8-31344)

(NASA-CR-150240) Avail: NTIS HC A04/MF A01 CSCL 14B

The specification of components for a spacecraft on-board optical processor was investigated. A space oriented application of optical data processing and the investigation of certain aspects of optical correlators were examined. The investigation confirmed that real-time optical processing has made significant advances over the past few years, but that there are still critical components which will require further development for use in an on-board optical processor. The devices evaluated were the coherent light valve, the readout optical modulator, the liquid crystal modulator, and the image forming light modulator.Author

N77-22170# Wentworth Inst., Boston, Mass.

ROCKET-BORNE IR SENSOR DEPLOYMENT SYSTEM Final Report

Thomas J. Campbell 31 Mar. 1976 26 p

(Contract F19628-73-C-0232; AF Proj. 7659)

(AD-A032307; AFGL-TR-76-0125; Scientific-3) Avail: NTIS HC A03/MF A01 CSCL 17/5

A control system was designed and developed to deploy, position, and stow a rocket-borne IR telescope. Author (GRA)

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

N77-22171# National Aerospace Lab., Tokyo (Japan).

AN EXPERIMENTAL-ANALYTICAL CALCULATION OF COMBUSTION PERFORMANCE OF LOX/GH2 ROCKET WITH COAXIAL INJECTORS

Nobuyuki Yatsuyanagi, Akio Suzuki, Hiromi Gomi, and Hiroshi Sakamoto Sep. 1976 22 p refs In JAPANESE; ENGLISH summary

(NAL-TR-472) Avail: NTIS HC A02/MF A01

A semi-analytical calculation of combustion gas parameters and the characteristic velocity performance, based on the experimental pressure distribution of LOX/GH2 rocket combustion chambers with constant cross-sectional areas and coaxial type injectors. The thrust level was 300 kgf with a nominal chamber pressure of 20 atm. The oxidant-fuel mixture ratios ranged from approximately 2 to 10. The combustion chamber geometry varied in lengths from 11 to 26 cm and contraction ratios of 2.03, 3.41 and 4.46, with a constant nozzle throat area. The injector has twelve coaxial elements with three replaceable faceplates having different hydrogen port areas. Author

N77-22172# Frankford Arsenal, Philadelphia, Pa.

PROCESS STUDIES AND FABRICATION OF ROCKET MOTOR BODY BY AUSFORMING PROCESS Final Engineering Report

Duane D. Gustad and Glenn D. Bell Apr. 1976 55 p

(AD-A032734; FA-TR-76023) Avail: NTIS HC A04/MF A01 CSCL 13/8

Thermomechanical forging of the 105mm XM548 rocket motor body was investigated during this study. Both ausforming and hot-cold working were investigated using 4340 and D6ac steels. Ausforming resulted in the greatest improvement in yield and tensile strength but at a sacrifice in ductility and impact resistance. Hot-Cold working appears to be the most desirable processing method for achieving mechanical property improvement with no reduction in ductility and impact strength over conventional quenching and tempering. Machinability tests were also performed to compare machinability of TMT steel with conventional quenched and tempered steel. These results showed machinability of TMT material to be equal to that of conventionally heat treated material. Author (GRA)

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N77-22173# Atomic Energy of Canada Ltd., Chalk River (Ontario).

AN EVALUATION OF SOME REPLICATION TECHNIQUES FOR MATERIALS SCIENCE APPLICATIONS OF SCANNING ELECTRON MICROSCOPY

G. J. C. Carpenter and J. Baird Jun. 1976 19 p refs

(AECL-5545) Avail: NTIS HC A02/MF A01

Several techniques for producing positive replicas have been critically examined: (1) Consistent high resolution replicas can be produced by vacuum evaporation of a gold film onto a cellulose acetate negative replica, backing the film with electroplated copper, and dissolving the Bioden; (2) negative replicas that are easy to strip and handle are made using a silicone rubber compound with highly variable resolution; and (3) an epoxy resin gave good resolution but could not easily be stripped from a specimen surface: it is therefore only suitable for the final (positive) stage of replication. Author

N77-22174# Georgetown Univ., Washington, D.C. Dept. of Chemistry.
ORGANIC DERIVATIVES OF HETEROPOLY MOLYBDATES
Michael T. Pope, Carl O. Quicksall, Wonsuk Kwak, L. M. Rajdovic, and Judith K. Stalick Nov. 1976 10 p refs
(Contract N00014-75-C-0945)
(AD-A032543; TR-4) Avail: NTIS HC A02/MF A01 CSCL 07/3

Heteropoly molybdate(VI) and tungstate(VI) anions are typically ionic oxometallate clusters of high symmetry, large size, and high ionic weight. They are usually the anions of strong acids; they form salts that are soluble in a variety of aqueous and nonaqueous solvents; and they may also undergo a series of reversible electron transfer reactions to yield mixed valence (V, VI) heteropoly blues. It has been customary to represent the structures of heteropoly anions as assemblages of metal-oxygen polyhedra which share corners, edges, and occasionally faces, and to invoke electrostatic arguments (Pauling's Rules) to rationalize bond-lengths and angles. Author (GRA)

N77-22175# Georgetown Univ., Washington, D.C. Dept. of Chemistry.
TWO HETEROPOLY ANIONS CONTAINING ORGANIC GROUPS. THE CRYSTAL AND MOLECULAR STRUCTURES OF AMMONIUM PENTAMOLYBDOBIS (METHYLPHOSPHONATE) PENTAHYDRATE AND SODIUM TETRAMETHYLAMMONIUM PENTAMOLYBDOBIS (ETHYLAMMONIUMPHOSPHONATE) PENTAHYDRATE
Judith K. Stalick and Carl O. Quicksall Nov. 1976 25 p refs
(Contract N00014-75-C-0945)
(AD-A032542; TR-3) Avail: NTIS HC A02/MF A01 CSCL 07/2

The crystal and molecular structures of two stable organic derivatives of a heteropoly anion have been determined from three-dimensional X-ray data collected by counter methods. GRA

24 COMPOSITE MATERIALS

Includes laminates.

N77-22176*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SONIC ENVIRONMENT TESTS OF AN INSULATOR/ABLATOR MATERIAL
L. Robert Jackson, Allan H. Taylor (Vought Corp., Hampton, Va.), and Carl E. Rucker Apr. 1977 18 p refs
(NASA-TM-X-74022) Avail: NTIS HC A02/MF A01 CSCL 11D

A 50.8 cm (20 inch) square panel of perpyrolized insulator/ablator was subjected to six 30-minute tests at 160 and 158 dB in the Langley Thermo-Acoustic Fatigue Apparatus (TAFA). This environment simulates the aerodynamic and engine noise encountered by a research airplane while in captive flight on the B-52 pylon during takeoff and climb. The pyrolized layer sustained damage in the form of three chips and numerous cracks. The chips occurred during the first test. Some cracking resulted during aerodynamic heating tests, and additional cracking resulted from the sonic environment tests. Author

N77-22177*# Sikorsky Aircraft, Stratford, Conn.
BEARINGLESS HELICOPTER MAIN ROTOR DEVELOPMENT. VOLUME 2: COMBINED LOAD FATIGUE EVALUATION OF WEATHERED GRAPHITE/EPOXY COMPOSITE Final Report, May 1975 - Dec. 1976
Joseph J. Rackiewicz [1977] 50 p refs
(Contract NAS1-13882)
(NASA-CR-145144; SER-70238-Vol-2) Avail: NTIS HC A03/MF A01 CSCL 11D

Small scale combined load fatigue tests were conducted on six artificially and six naturally weathered test specimens. The test specimen material was unidirectionally oriented A-S graphite - woven glass scrim epoxy resin laminate. Author

N77-22178*# Lockheed-Georgia Co., Marietta.
DEVELOPMENT OF THE TECHNOLOGY FOR THE FABRICATION OF RELIABLE LAMINAR FROM CONTROL PANELS Final Technical Report, Apr. - Sep. 1976
L. E. Meade, A. O. Kays, R. S. Ferrill, and H. R. Young Feb. 1977 91 p refs
(Contract NAS1-14409)
(NASA-CR-145168) Avail: NTIS HC A05/MF A01 CSCL 11D

Materials were assessed and fabrication techniques were developed for use in the manufacture of wing surface materials compatible with the application of both aluminum alloys and nonmetallic composites. The concepts investigated included perforations and slots in the metallic test panels and microporosity and perforations in the composite test panels. Perforations were produced in the metallic test panels by the electron beam process and slots were developed by controlled gaps between the metal sheets. Microporosity was produced in the composite test panels by the resin bleed process, and perforations were produced by the fugitive fiber technique. Each of these concepts was fabricated into test panels, and air flow tests were conducted on the panels. Author

N77-22179*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPOSITE LAMINATION METHOD Patent Application
George E. Dickerson, inventor (to NASA) Filed 28 Apr. 1977 14 p
(NASA-Case-LAR-12019-1; US-Patent-AppISN-792067) Avail: NTIS HC A02/MF A01 CSCL 11D

A process for preparing relatively thick composite laminate structures wherein thin layers of prepreg tapes are assembled is presented. These thin layers are cut into strips that are partially cured, and stacked into the desired thickness with uncured prepreg disposed between each layer of strips. The laminate is cured and thereafter machined to the desired final dimensions. NASA

N77-22180*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Coll. of Engineering.
TENSILE AND COMPRESSIVE TEST RESULTS FOR METAL MATRIX COMPOSITES Interim Report
Mark J. Shuart and Carl T. Herakovich Feb. 1977 50 p refs
(Grant NGR-47-004-129)
(NASA-CR-152697; VPI-E-77-6) Avail: NTIS HC A03/MF A01 CSCL 11D

Experimental results of the mechanical behavior of two metal matrix composite systems at room temperature are presented. Ultimate stress, ultimate strain, Poisson's ratio, and initial Young's Modulus are documented for BORSIC/Aluminum in uniaxial tension and Boron/Aluminum in uniaxial tension and compression. Poisson's ratio is used for nonlinear stress-strain behavior. A comparison of compression results for B/Al as obtained from sandwich beam compression specimens and IITRI coupon compression specimens is presented. Author

N77-22181# Sandia Labs., Albuquerque, N.Mex.
EFFECTS OF POROSITY AND STRUCTURE OF GRAPHITE MATERIALS ON ABLATION IN ARC GENERATED PLASMAS
I. Auerbach, Morton L. Lieberman, Katheryn E. Lawson, and Hugh O. Pierson Jul. 1976 34 p refs
(Contract E(29-1)-789)
(SAND-76-0176) Avail: NTIS HC A03/MF A01

The ablation performance of chemically vapor deposited carbon on a carbon felt made from polyacrylonitrile fiber (CVD/PAN), ATJ-S, and ATJ-S precursor graphites was studied in an arc jet at stagnation pressures and bulk gas enthalpies. The initial nonlinear ablation kinetics represents a period when thermal and chemical equilibrium are approached. In the subsequent steadystate period, the ablation rate is constant. The kinetics are modeled with a relationship in which the rate constant operative during the steady state period is controlled by an exponential term that modifies the rate during the initial period. Correlation with experimental data is good. The ablation performances of CVD/PAN, ATJ-S, and its precursors are exponentially related to their porosities. Nonuniform surface ablation also correlates with porosity, fiber density, and the fiber-matrix interfacial spacing. The ablation performance of CVD/PAN can be made competitive with ATJ-S if its porosity is reduced. ERA

N77-22182# Michigan State Univ., East Lansing.
ELECTRONIC EXCITATION OF COMPOSITE SYSTEMS Progress Report, 1 Aug. 1975 - 31 Jul. 1976
M. Ashraf El-Bayoumi Apr. 1976 6 p
(Contract E(11-1)-2039; AT(11-1)-2039)
(COO-2039-30) Avail: NTIS HC A02/MF A01

The effects of pH and temperature solvent deuteration on the fluorescence spectra and quantum yields of 7-azaindole in ethanol and in water were studied. Evidence was provided for double proton transfer in 7-azaindole complexes with alcohol and water. Observation of double proton transfer in a model system azacarbazole was made. Synthesis of the compound and its corresponding tautomer were completed. Fluorescence measurements under various conditions were performed. The effects of temperature and polarity of the medium on the fluorescence yield and life-time of a fluorescence-polarity probe (namely, dansylsulfonamide) were also studied along with the effect of the solvent-deuterium isotope substitution. Polarization decay measurements of rhodamine B in glycerol at room temperature were performed. ERA

N77-22183# Bendix Corp., Kansas City, Mo.
ANALYSIS OF THICK FILM CONDUCTOR INKS
D. H. Brewer Sep. 1976 23 p refs
(Contract E(29-1)-613)
(BDX-613-1491; PDO-6984903) Avail: NTIS HC A02/MF A01

A project undertaken to determine the ink characteristics affecting fired films is described. The analytical methods used were thermogravimetric analysis, pyrolysis-gas chromatography, infrared spectrophotometry, mass spectrometry, atomic absorption spectrophotometry, scanning electron microscopy with energy dispersive x-ray spectroscopy, and particle size analysis using a Coulter counter. ERA

N77-22184# Los Alamos Scientific Lab., N. Mex.
YIELD STRENGTHS OF TUNGSTEN-BASE COMPOSITES DETERMINED FROM BEND TESTS
Eugene G. Zukas and David T. Eash Aug. 1976 10 p refs
(Contract W-7405-eng-36)
(LA-6450-MS) Avail: NTIS HC A02/MF A01

The variation in yield strength with either strain rate or temperature was determined for a number of tungsten-base composites by use of the simple three-point bend test. The yield strengths were comparable with those obtained in standard tensile tests. Additional studies on 1019 steel, either in the as-rolled or annealed condition, gave results in agreement with handbook values, as did two aluminum alloys. These results demonstrate that the bend test deserves wider acceptance in materials testing programs. ERA

N77-22185# California Univ., Livermore. Lawrence Livermore Lab.
SPECIFICATION FOR KEVLAR 49 FIBER AND SAMPLING PLAN FOR TENSILE STRENGTH
Lynn Penn and N. Hetherington 12 Aug. 1976 10 p ref
(Contract W-7405-eng-48)
(UCID-17229) Avail: NTIS HC A02/MF A01

A specification for Kevlar 49 yarn is presented along with a sampling plan for tensile strength. The specification may be used for purchase and acceptance or for quality control of Kevlar 49 yarn (380 denier). Applied to yarn used in high-performance filament wound composite applications, it calls for clear definition of the material chemically, physically, and mechanically. The material must conform to preset standards of linear weight (denier), chemical structure, density, water content, and tensile properties. Recommended test procedures are included. The sampling plan is based on tensile strength, and the tensile property values listed stem from prior experience with the material. The sampling plan is a sequential acceptance type that applies to a property for which a minimum value is set. ERA

N77-22186# Fiber Materials, Inc., Biddeford, Maine.
SELECTIVE REINFORCEMENT OF ALUMINUM I-BEAMS WITH GRAPHITE-ALUMINUM COMPOSITE WIRE Final Technical Report, 13 Mar. 1975 - 12 Apr. 1976
H. Gigerenzer and G. C. Strempek Jun. 1976 34 p refs
(Contract DAAG46-75-C-0060)
(AD-A031437; AMMRC-CTR-76-19) Avail: NTIS HC A03/MF A01 CSCL 11/6

Standard 6061 aluminum I-beams were selectively reinforced on the flanges with single strand T50 graphite/6061 aluminum composite wire reinforcements by utilizing a hot isostatic pressing (HIP) process. Preliminary mechanical hot pressing trials on graphite-aluminum sandwich construction panels were conducted to investigate the effects of both solid and liquid state processing parameters on composite flexural properties. Mechanical test data on these panels indicated that solid state bonding conditions resulted in higher flexural strength and modulus than liquid state conditions. Based on these results, lay-up and containment was designed to hot isostatically press in the solid state 0.040 inch (0.102 cm.) thick graphite-aluminum layers to the flanges of four standard 6061 aluminum I-beams. Metallographic examination of sections from the HIP processed I-beams showed consolidation had been achieved between the graphite-aluminum composite wires and to the I-beam flange interfaces. However, some sections showed micro-cracks within the composite layers and at the composite layer/I-beam flange interface due to high residual stresses induced during thermal contraction of the I-beam upon cooling from the HIP processing temperature. GRA

N77-22187# Materials Research Labs., Maribyrnong (Australia).
ENVIRONMENTAL EFFECTS ON THE MECHANICAL PROPERTIES OF HIGH PERFORMANCE FIBRES
J. R. Brown and N. McM. Browne Aug. 1976 28 p refs
(AD-A032858; MRL-R-674) Avail: NTIS HC A03/MF A01 CSCL 11/5

Some environmental effects on the mechanical properties of the high performance fibers PBI, Nomex and Kevlar 49 are discussed. Thermal stabilities are given in terms of the changes in mechanical properties such as tensile strength, elongation at break and energy to break after thermal aging at various elevated temperatures in inert and oxidizing conditions. The effects of exposure to sunlight and ionizing radiation are shown by similar measurements. The dimensional stability of the fibers at elevated temperatures and the effects of thermal aging, exposure to sunlight and ionizing radiation on the flammability properties of PBI and Nomex are discussed. Author (GRA)

N77-22188# Prototype Development Associates, Inc., Santa Ana, Calif.
EVALUATION OF CARBON-CARBON COMPOSITE NOSETIP MATERIALS Final Report, 1 Jul. 1975 - 30 Apr. 1976
John R. Stetson and J. C. Schutzler Oct. 1976 184 p refs
(Contract DAAG46-75-C-0099)
(AD-A033540; PDA-TR-1042-00-09; AMMRC-CTR-76-34)
Avail: NTIS HC A09/MF A01 CSCL 11/4

Fourteen orthogonally-reinforced carbon-carbon materials were evaluated for application to terminal defense interceptor (ATDI) nosetip concepts. The preforms were woven from four different types of graphite yarns manufactured from PAN, rayon and an experimental pitch-precursor. Weave geometries represented a complete range of preform characteristics in terms of weave fineness and balance. Ablation tests were performed at three stagnation presure levels up to 168 atmospheres, and post-test analyses of the material ablation performance were conducted. Five of the most promising materials were strength-tested, and a complete engineering properties data base was developed for one of the materials (AMMRC/FMI 221). Nosetip designs were developed for a typical ATDI mission, and four prototype full-scale models were fabricated and tested in a high pressure rocket exhaust facility. One nosetip model of AMMRC/FMI 221 was fabricated for flight test and analyzed for thermal and structural performance. It was demonstrated in this program that certain fine-weave carbon-carbon materials of the type evaluated will provide stable, symmetric nosetip shapes while undergoing high pressure, turbulent recession in ATDI environments. In addition, it was shown that these materials can be tailored, by weave configuration design, for specific bending strength requirements. Intercept missions through severe weather environments require an erosion-resistant subtip such as tungsten. Author (GRA)

N77-22189# Washington State Univ., Pullman. Dept. of Materials Science and Engineering.

ELECTROPOLYMERIZATION ON CARBON FIBERS: EFFECTS ON COMPOSITE PROPERTIES

R. V. Subramanian and James J. Jakubowski Dec. 1976 17 p refs Presented at SPE 2d Ann. Pacific Tech. Conf., Seattle, 10-12 Aug. 1976 Submitted for publication

(Contract N00014-75-C-0792; NR Proj. 356-592)

(AD-A033564; TR-1) Avail: NTIS HC A17/MF A01 CSCL 11/4

Interface tailoring in carbon fiber-polymer composites by means of electrochemical polymerization has been investigated. It was expected that fiber-matrix adhesion and composite mechanical properties can be modified by the electrochemical formation of polymer layers of varying structure and properties on carbon fibers prior to their incorporation in a polymer matrix. Techniques were developed first for producing thin polymer coatings on carbon fibers by using the latter as electrodes in an electrolytic cell containing the monomer. Composite specimens were prepared by the incorporation of the coated fibers in an epoxy matrix. It was demonstrated that, in fact, the effect of the surface treatment on the interfacial properties of the resulting composite was manifested in variations of the measured interlaminar shear and impact strengths of the composite specimens. The increase in interlaminar shear was considered to be the result of improved fiber-matrix adhesion when compared to composite specimens prepared from untreated carbon fibers. The corresponding reversed trend in impact strength values was attributed to the effect of excessive fiber-matrix adhesion in causing brittle failure of the composite. It was significant when, in exception to this general trend, it was also found that both interlaminar shear and impact strengths could simultaneously be increased. GRA

N77-22190# Technion Research and Development Foundation Ltd., Haifa (Israel).

MECHANICAL BEHAVIOR OF MULTIMATERIAL COMPOSITE SYSTEMS: INTERLAMINAR BEHAVIOR Final Technical Report, Oct. 1975 - Mar. 1976

Ori Ishai, Dan Peretz, and Shlomit Gali Apr. 1976 103 p refs

(Contract DAJA37-75-C-1890; DA Proj. 1T1-61102-B-35E)

(AD-A032011) Avail: NTIS HC A06/MF A01 CSCL 11/1

Stress analysis of interlaminar adhesive layer (IAL) within a multimaterial doubler model which was evaluated in the previous years work is further investigated. Two dimensional IAL stress distribution was derived by means of the finite element method, with emphasis on the behavior close to the edges. Thermoelastic behavior of symmetrical and nonsymmetrical models was investigated analytically and experimentally. A direct method for measuring IAL stress and strain distribution was developed and compared successfully with the analytical predictions. These studies provide a wider basis for current and future research into the non-linearity and ultimate behavior of the IAL.

Author (GRA)

N77-22191# Southwest Research Inst., San Antonio, Tex.

STRENGTH BEHAVIOR OF GRAPHITE/EPOXY COMPOSITE LAMINATES UNDER BIAXIAL LOAD Annual Report, 15 Feb. 1975 - 15 Feb. 1976

P. H. Francis, D. E. Walrath, and D. N. Weed Jul. 1976 83 p refs

(Contract F33615-75-C-5115)

(AD-A032127; AFML-TR-76-86) Avail: NTIS HC A05/MF A01 CSCL 11/4

The room temperature mechanical ply properties of Fiberite hy-E 1034C graphite/epoxy composite material were characterized using unidirectional thin wall tubes and flat coupons. Four ply laminated tubes having (0/90)s and plus or minus (45)s stacking sequences were fabricated in preparation for biaxial experiments to determine first ply failure (FPF) thresholds. Initial results using acoustic emission techniques to detect FPF on (0/90)s tubes are reported. GRA

N77-22192# Rockwell International Science Center, Thousand Oaks, Calif. Science Center.

STUDY OF INTERMETALLIC COMPOUNDS Final Report, 17 Feb. 1975 - 17 Feb. 1976

C. G. Rhodes, A. G. Evans, and N. E. Paton Jun. 1976 67 p refs

(Contract F33615-75-C-1090)

(AD-A032136; AFML-TR-76-105) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report describes results of mechanical property tests and microstructure studies on a series of alloys based on the intermetallic compounds Ti3Al (alpha 2) and TiAl (gamma). This class of alloys has shown considerable promise for high temperature applications and the objective of this program has been to study the microstructure of a series of alloys containing both the alpha 2 and gamma phases with a view to improving the mechanical properties. It has been shown that a variety of microstructures can be produced in a Ti-26% Al - 10% Nb base alloy, either by addition of ternary and quaternary alloying elements, or by heat treatment. GRA

N77-22193# National Bureau of Standards, Washington, D. C.

NON-METALLIC ANTENNA-SUPPORT MATERIALS PULTRUDED RODS FOR ANTENNA GUYS, CATENARIES AND COMMUNICATIONS STRUCTURES Final Technical Report, Oct. 1971 - Oct. 1974

N. Halsey, D. E. Marlowe, R. A. Mitchell, and L. Mordfin Wright-Patterson AFB Ohio AFML May 1976 146 p refs

(Contract F33615-72-M-5000)

(AD-A031775; AFML-TR-76-42) Avail: NTIS HC A07/MF A01 CSCL 11/4

Both E-glass and Kevlar 49 (aramid) fibers were used to reinforce an isophthalic polyester resin. These materials were used, in turn, to form pultruded antenna rod hardware for structural tests. The aramid material exhibited substantially improved strength-retention properties over the glass-reinforced material under prolonged exposure to heat and humidity. The aramid material offers the promise of superior weatherability in antenna-support applications although further testing is warranted. The stress-rupture properties of pultruded rod, under high humidity, possess unusual temperature and time dependencies. These are explained in terms of the mechanisms whereby moisture is transported from the environment to the fiber/matrix interface. The stress-rupture properties, as well as the tensile properties, may be improved by appropriately modifying the pultrusion process. Two new end fittings, generally capable of attaining the full tensile strength of glass fiber-reinforced pultruded rod, were developed. Several new test methods were developed, including and environmental stress-rupture test, two methods for investigating the quality of the fiber/matrix interface, and a method for examining the rate sensitivity of the tensile strength. A significant rate sensitivity was observed for glass fiber-reinforced rod but not for aramid fiber-reinforced rod. Author (GRA)

N77-22194# Michigan Univ., Ann Arbor. Dept. of Mechanical Engineering.

MOISTURE ABSORPTION AND DESORPTION OF COMPOSITE MATERIALS Annual Technical Report, Mar. 1975 - Mar. 1976

George S. Springer and Chi-Hung Shen Jun. 1976 72 p refs

(Contract F33615-75-C-5165)

(AD-A031436; AFML-TR-76-102) Avail: NTIS HC A01/MF A01 CSCL 11/4

Expressions are presented for the moisture distribution and the moisture content as a function of time of one dimensional homogeneous and composite materials exposed either on one side or on both sides to humid air or to water. The results apply during both moisture absorption and desorption when the moisture content and the temperature of the environment are constant. Test procedures are described for determining experimentally the values of the moisture content and the diffusivity of composite materials. A series of tests using unidirectional and Graphite T-300 Fiberite 1034 composites were performed in the temperature range 300-425 K with the material submerged both in moist air (humidity 0 to 100%) and in water. The test data support the analytical results and provide the moisture absorption and desorption characteristics of such composites. Extension of the results to materials exposed to time varying environmental conditions is indicated. Attempts were made to correlate the moisture content of the material with (1) changes in electric resistance and (2) changes in the hardness of the material. The latter method promises to provide an indication of the moisture content. GRA

N77-22195# Brobeck (William M.) and Associates, Berkeley, Calif.
INVESTIGATION OF MULTI-RING FIBER-COMPOSITE FLYWHEELS FOR ENERGY STORAGE Final Report
J. W. Pepper Sep. 1976 142 p refs Sponsored by EPRI
(PB-260718/2; EPRI-EM-227) Avail: NTIS HC A07/MF A01 CSCL 11D

Test of fiber glass composite flywheels and the dynamics of the pendular support system are described. Results of tests on one and two concentric ring systems up to a surface speed of 1,630 ft. per minute and energy density of 14.2 watt-hours per pound are reported. Designs and test results on various means of ring support from the hub and from adjacent rings are included. GRA

N77-22196# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.
SOFTBODY IMPACT RESISTANCE OF BERYLLIUM/TITANIUM COMPOSITE BLADES Final Technical Report, 1 Jul. 1975 - 31 Mar. 1976
Richard L. Fannin May 1976 39 p refs
(Contract N00019-75-C-0503)
(AD-A032438; DDA-EDR-8806; AFAPL-TR-76-69) Avail: NTIS HC A03/MF A01 CSCL 01/3

Seven prototype Be/Ti aircraft engine fan blades had been fabricated during a previous program. From all indications, the blades were dimensionally and structurally sound except for indication of poor attachment bonding. Two of the fan blades were selected, based on strength considerations, for demonstration of structural capability by overspeed and softbody impact testing. The testing demonstrated that the Be/Ti metal matrix system can have good tensile strength and softbody impact capability, however good root attachment bonding is essential.
Author (GRA)

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N77-22197 North Carolina State Univ., Raleigh.
PHOTOEXCITATION STUDIES OF NICKEL(II) COMPLEXES USING OPTICAL AND MAGNETIC CIRCULAR DICHROISM TECHNIQUES Ph.D. Thesis
Donald Joseph Hamm 1976 105 p
Avail: Univ. Microfilms Order No. 76-28484

Seven compounds of hexamminenickel (II), [ch173]Ni(NH3)6] A2, or their deuterated analogues, were investigated by means of optical, magnetic circular dichroism (MCD), laser Raman spectroscopy, or single crystal X-ray diffraction. Optical and MCD measurements were carried out between 18 K and room temperature on mulls, solutions, in KBr disks, or single crystals. The optical data in the d-d region of the (Ni(NH3)6)A2 complexes, along with a weak field, crystal field calculation including spin-orbit coupling and complete configuration interaction, permitted the assignment of new bands and the finding of extensive new fine structure on most of the bands. This fine structure was found to consist of vibronic progressions in which several (NiN6) skeletal normal modes are activating electronic excitations.
Dissert. Abstr.

N77-22198 Oklahoma State Univ., Stillwater.
USE OF TRANSIENT EFFECTS IN THE REPETITIVE DETERMINATION OF A VARIETY OF CHEMICAL SPECIES IN SOLUTIONS Ph.D. Thesis
Adel Hanna Eskander-Hanna 1976 165 p
Avail: Univ. Microfilms Order No. 77-5069

A flow injection technique and spectrometric monitoring of signal-time profiles is described for the determination of micro and submicrogram amounts of phenothiazines, vanadate, dichromate, zinc, and cadmium in solutions. These profiles show peaks whose heights can be simply related to the amounts of the injected species and indicate that these transient signals follow consecutive pseudo-first order kinetics in presence of large excess of the other reagents as shown by computational and curve-fitting techniques. The repeated use of the same reaction mixture eliminates reagent handling, washings between determinations, and excessive consumption of reagents. In addition, determination times are usually in the order of 10 to 20 seconds, which permits analyzing 360 to 180 samples per hour.
Dissert. Abstr.

N77-22199# California Univ., Berkeley. Lawrence Berkeley Lab.
APPLICATION OF ELECTROCHEMICAL ENGINEERING PRINCIPLES TO ENERGY CONSERVATION PROBLEMS
C. W. Tobias Jul. 1976 11 p refs Presented at the Workshop Energy Conserv. in Ind. Electrochem. Process., Argonne, Ill., 10 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5404; Conf-760840-1) Avail: NTIS HC A02/MF A01

The discrepancy between the early development of industrial electrochemical processes (such as electrometallurgy) and the lack of research on the thermodynamics and kinetics involved is emphasized in order to indicate the necessity for a chemical engineering approach to industrial electrochemical processes and possible research orientations. ERA

N77-22200# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTROCHEMICAL SYSTEMS: IMPEDENCE OF A ROTATING DISK AND MASS TRANSFER IN PACKED BEDS Ph. D. Thesis
P. W. Appel May 1976 168 p refs
(Contract W-7405-eng-48)
(LBL-5132) Avail: NTIS HC A08/MF A01

The impedance of a rotating disk is calculated under conditions where the time average current to the disk is below the limiting current. The reaction at the surface of the disk is of the redox type; consequently the influence of product concentrations on the disk impedance has to be included in the calculations. The double layer theory is used to calculate the surface excesses of all ionic species present in the solution with the assumption that there is no specific adsorption. It is shown that under these circumstances, the concentration fluctations of both cation and anion of the supporting electrolyte caused by migration are of the same order of magnitude as the concentration fluctuations of reactant and product. Therefore, the usual treatment of eletrochemical impedance problems, neglecting the influence of the supporting electrolyte, is not a priori valid. The last part of the thesis describes the application of the limiting current technique to mass transfer studies of packed beds at very low Peclet numbers. ERA

N77-22201# Sandia Labs., Albuquerque, N.Mex.
EFFECT OF WATER ON IONIC CONDUCTIVITY AND DIFFUSION IN Na2O.3SiO2 GLASSES
G. L. McVay, M. L. Knotek, R. T. Johnson, Jr., R. J. Baughman, and R. J. Eagan Sep. 1976 26 p refs
(Contract E(29-1)-789)
(SAND-76-0384) Avail: NTIS HC A02/MF A01

The diffusion coefficient and ionic conductivity of Na(+)-ions was measured as a function of temperature in a (NaO2) (3Si O2) glass which contained concentrations of water ranging from 0.011 to 0.086 mole percent. The diffusion coefficient was determined by tracer diffusion measurements using Na-22 Ionic conductivity measurements were made using 2-, 3-, and 4-terminal ac and dc techniques. Results show that the effect of H2O on the diffusion coefficient and the ionic conductivity is similar, both decreasing with increasing H2O concentration; and the correlation factor has a value of about 0.5 (or less) and is weakly temperature dependent. ERA

N77-22202# Brandeis Univ., Waltham, Mass.
HYDROGEN-TRANSFER AND CHARGE-TRANSFER IN PHOTOCHEMICAL AND RADIATION INDUCED REACTIONS Progress Report, 1 Nov. 1975 - 31 Oct. 1976
S. G. Cohen Oct. 1976 11 p refs
(Contract EY-76-S-02-3118)

(COO-3118-11) Avail: NTIS HC A02/MF A01

The relative importance of light absorption, quenching of triplet, and hydrogen transfer repair was examined in retardation by mercaptans of photoreduction of aromatic ketones by alcohols. In the reduction of benzophenone by 2-propanol, retardation is efficient and, after correction for the first two effects, is due entirely to hydrogen transfer repair, as indicated by deuterium labeling. In reduction of acetophenone by alph methylbenzyl alcohol, repair by hydrogen transfer is also operative. In reduction of benzophenone by benzhydrol, retardation is less efficient and is due to quenching, as the ketyl radical does not abstract hydrogen from mercaptan rapidly in competition with coupling. Deuterium isotope effects are discussed in terms of competitive reactions. Photoreduction of benzophenone by 2-butylamine and by triethylamine is retarded by aromatic mercaptans and disulfides. ERA

N77-22203# Energy Research and Development Administration, Washington, D.C.

CARBON DIOXIDE FIXATION AND SYNTHETIC CHEMISTRY

Shohei Inoue 1974 23 p refs Transl. into ENGLISH from Kagaku (Kyoto) Zokan, v. 63, 1974 p 29-51

(RFP-Trans-186) Avail: NTIS HC A02/MF A01

An extensive bibliographic review is given of the principal chemical reactions of CO2. These include reactions with metal compounds, carboxylation accompanied by rearrangement, and polymer formation reactions. Electrolytic reactions are also briefly considered. Particular attention is given to the biochemical fixation of CO2 in photosynthesis and the model reactions involved. Author (ERA)

N77-22204# Energy Research and Development Administration, Washington, D.C.

FUTURE FOR THE UTILIZATION OF CARBON DIOXIDE GAS

Shohei Inoue 1973 32 p refs Transl. into ENGLISH from Koatsu Gasu (Tokyo), v. 10, no. 3, 1973 p 144-152

(RFP-Trans-184) Avail: NTIS HC A03/MF A01

The chemical reactions of CO2, particularly those of industrial importance, are reviewed. Biochemistry and the model reactions involved in photosynthesis are outlined. ERA

N77-22205# California Univ., Livermore. Lawrence Livermore Lab.

HOMOGENEOUS THERMAL DISSOCIATION OF FORMALDEHYDE

H. G. Schecker and W. Jost Oct. 1976 14 p refs Transl. into ENGLISH from Ber. Bunsenges. Phys. Chem. (West Ger.), v. 73, no. 6, 1969 p 521-526 Sponsored by ERDA

(UCRL-Trans-11179) Avail: NTIS HC A02/MF A01

The thermal dissociation of formaldehyde at low concentrations in argon as carrier gas was investigated at temperatures 1400 less than T less than 2200 K. It could be shown that consecutive reactions of the unimolecular dissociation were important even at concentrations as low as 0.02 percent. After analysis of these consecutive reactions, a rate constant of the unimolecular dissociation of about 10/sup 16.7/ exp (-72 kcal.mole/RT) sq cm mol sec could be determined. The consequences on the values of the dissociation energies D(H-HCO) and D(H-CO) are discussed. ERA

N77-22206# Mound Lab., Miamisburg, Ohio.

POTENTIAL APPLICATION OF GAS CHROMATOGRAPHY TO THE ANALYSIS OF HYDROGEN ISOTOPES

D. K. Warner, R. E. Sprague, and D. R. Bohl 20 Sep. 1976 9 p refs

(Contract E-33-1-GEN-53)

(MLM-2356) Avail: NTIS HC A02/MF A01

Gas chromatography was used for the analysis of hydrogen isotopic impurities in gas mixtures. This instrumentation was used to study the applicability of the gas chromatography technique to the determination of the major components of hydrogen isotopic gas mixtures. The results of this study, including chromatograms and precision data, are presented. ERA

N77-22207# Arizona Univ., Tucson. Dept. of Chemistry.

A NEW APPROACH TO SIMPLEX OPTIMIZATION: THE SUPER MODIFIED SIMPLEX

M. W. Routh, P. A. Swartz, and M. B. Denton 1976 61 p refs

(Contract N00014-75-C-0513; NR Proj. 051-549)

(AD-A031926; TR-9) Avail: NTIS HC A04/MF A01 CSCL 14/2

A new, improved simplex optimization procedure has been developed which significantly increases the utility, reliability, and efficiency of current state-of-the-art simplicial methods in the presence of random response fluctuations. Comparison of this improved procedure, the Super Modified Simplex (SMS), with several variations of the modified simplex approach using an interactively computer-controlled flame spectrophotometer reveals its inherent superiority in rapidly and efficiently conforming to multi-dimensional response surface topography. Data are presented which indicate fewer simplices and data points, as well as a reduction in experimental time results when the SMS procedure is employed. Moreover, failure to satisfactorily locate the optimum in the presence of noise due to premature diminution of the simplex, adherence to false ridges, or inability to accurately home in on the optimum is minimized. When the optimum region lies at or near a boundary constraint, the SMS procedure allows the simplex to elongate along and more rapidly adhere to the constraint if such a parameter value is indicated. GRA

N77-22208# National Bureau of Standards, Washington, D. C. Physical Chemistry Div.

THE MEASUREMENT OF IONIZATION AND APPEARANCE POTENTIALS Final Report

H. M. Rosenstock 28 Aug. 1975 52 p refs Repr. from Inst. J. Mass Spectrom. Ion Phys., v. 20, 1976 p 139-190

(PB-260865/1) Avail: NTIS HC A04/MF A01 CSCL 07D

Measurement techniques and methods of data interpretation leading to ionization potentials, appearance potentials and heats of formation of gaseous positive ions are summarized and critically discussed. Special attention is paid to defining the accuracies, problems, and limitations of the techniques and interpretations. GRA

N77-22209# Naval Surface Weapons Center, White Oak, Md.

STRUCTURE IDENTIFICATION VIA MASS SPECTROMETRY, TETRANITRO AZOXY AND AZOTOLUENES

D. A. Kubose and D. J. Glover 10 Sep. 1976 20 p refs

(AD-A032831; NSWC/WOL/TR-76-96) Avail: NTIS HC A02/MF A01 CSCL 07/4

The mass spectra of 2,2',6,6'-tetranitro-4,4'-azoxytoluene, 4,4',6,6'-tetranitro-2,2'-azoxytoluene and their mixed isomers 2,4'-dimethyl-3,3',5,5'-tetranitro-ONN-azoxybenzene and 2',4-dimethyl-3,3',5,5'-tetranitro-ONN-azoxybenzene are discussed, and arguments are presented for the assignment of structures to the mixed isomers. The mass spectra of the corresponding symmetrical azotoluene isomers are also presented. GRA

N77-22210# Princeton Univ., N.J. Solid State and Materials Lab.

THE STABILITY, ELECTRONIC AND SURFACE PROPERTIES OF THE ALKALI AZIDES Final Report, 1 Apr. 1973 - 30 Jun. 1976

Barrie S. H. Royce 1 Sep. 1976 18 p refs

(Contract DAAG29-73-C-0019)

(AD-A032414; PSSL-010976; ARO-11330.6-C) Avail: NTIS HC A02/MF A01 CSCL 07/4

Measurements of the thermal decomposition of KN3 are reported. The decomposition was found to be enhanced by the application of an electric field with the increased rate of nitrogen evolution due to the field being essentially independent of the sign of the field whereas the potassium evolution rate was found to be largest when the free surface of the crystal was negative. A model for this behavior is proposed. Theoretical calculations of the energies of Schottky pair formation, cation ion migration, cohesive energies, lattice parameters, specific volumes, azide liberational frequencies, and elastic moduli are also outlined. These have been made using a Born model of the azide lattice and attention directed at choosing a correct form for the azide repulsive potential. A bispherical form for this potential was developed and found to be superior in predicting the above properties over the series of alkali azides. Using the energies obtained in the above calculations, an analysis of cation diffusion in KN3 has

been carried out. An approximate analytic expression for the correlation factor was obtained and the temperature dependence of the elements of the diffusion temperature evaluated. GRA

N77-22211# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
NITROGEN TRIFLUORIDE ANALYTICAL PROCEDURES Final Report
Louis A. Dee and William T. Leyden Dec. 1976 24 p refs (AF Proj. 3058)
(AD-A033329; AFRPL-TR-76-89) Avail: NTIS HC A02/MF A01 CSCL 07/2

A gas chromatograph technique for the analysis of NF3 is described wherein N2, CO(O2), NO, CF4, NF3, CO2, N2O, SF6 and possibly N2F2 are separated isothermally on a single column. In addition, a simple total reactive fluoride measurement is presented. GRA

N77-22212# National Academy of Sciences - National Research Council, Washington, D. C. Advisory Center on Toxicology.
COMMITTEE ON FIRE TOXICOLOGY Six Month Progress Report
Jul. 1976 11 p refs
(Contract N00014-75-C-0718)
(AD-A033028; NAS/ACT/P-843-1) Avail: NTIS HC A02/MF A01 CSCL 06/20

The report outlines desirable characteristics for a screening test for determining the toxicity of combustion and pyrolysis products of polymeric materials. GRA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N77-22213*# International Nickel Co., Inc., Suffern, N. Y. Paul D. Merica Research Lab.
DEVELOPMENT OF OXIDE DISPERSION STRENGTHENED TURBINE BLADE ALLOY BY MECHANICAL ALLOYING
H. F. Merrick, L. R. Curwick, and Y. G. Kim Jan. 1977 69 p refs
(Contract NAS3-19694)
(NASA-CR-135150) Avail: NTIS HC A04/MF A01 CSCL 11F

There were three nickel-base alloys containing up to 18 wt. % of refractory metal examined initially for oxide dispersion strengthening. To provide greater processing freedom, however, a leaner alloy was finally selected. This base alloy, alloy D, contained 0.05C/15Cr / 2Mo/4W/2Ta/4.5Al/2.Ti/015Zr/0.01-B/Bal. Ni. Following alloy selection, the effect of extrusion, heat treatment, and oxide volume fraction and size on microstructure and properties were examined. The optimum structure was achieved in zone annealed alloy D which contained 2.5 vol. % of 35 mm Y2O3 and which was extruded 16:1 at 1038 C. Author

N77-22214*# TRW, Inc., Cleveland, Ohio.
STRAIN PARTITIONING OF THREE ALLOYS IN ULTRAHIGH VACUUM USING THE STEP STRESS METHOD Final Report, 14 May - 14 Nov. 1976
C. S. Kortovich Apr. 1977 49 p refs
(Contract NAS3-20103)
(NASA-CR-135187; TRW-ER-7926) Avail: NTIS HC A03/MF A01 CSCL 11F

The ultrahigh vacuum strain controlled thermal-mechanical strain cycling fatigue behavior of ASTAR 811C, 304 stainless steel and A-286 was studied. The step stress procedure of experimental strainrange partitioning was utilized to partition the inelastic strainranges for tests duplicating conditionings previously reported by TRW. An analytical method is described in which these partitioned inelastic strainrange data can be used to develop the four basic life relationships for these materials. Author

N77-22215*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CARBURIZATION AND HEAT TREATMENT TO CAUSE CARBIDE PRECIPITATION IN GAMMA/GAMMA PRIME-DELTA EUTECTIC ALLOYS
Surendra N. Tewari and Robert L. Dreshfield Washington May 1977 19 p refs
(NASA-TM-X-3518; E-8976) Avail: NTIS HC A02/MF A01 CSCL 11F

In an attempt to improve their longitudinal shear strength, several directionally solidified eutectic alloy compositions with minor element modifications were pact, carburized, and heat treated to provide selective carbide precipitation at the cell and grain boundaries. The directionally solidified Ni-17.8 Nb-6Cr-2.5Al-3Ta (weight percent) alloy was selected for the shear strength evaluation because it showed the shallowest delta-denuded zone at the carburized surface. The carburization-carbide precipitation treatment, however, did not appear to improve the longitudinal shear strength of the alloy. Author

N77-22216*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
X-RAY PHOTOELECTRON SPECTROSCOPIC STUDY OF SURFACE CHEMISTRY OF DIBENZYL-DISULFIDE ON STEEL UNDER MILD AND SEVERE WEAR CONDITIONS
Donald R. Wheeler Washington May 1977 18 p refs
(NASA-TN-D-8460; E-8962) Avail: NTIS HC A02/MF A01 CSCL 11F

Wear tests were performed on 304 stainless steel lubricated with pure mineral oil with and without dibenzyl-disulfide. Both mild and severe wear were observed. The type of wear was distinguished by a marked change in wear rate, friction coefficient, and wear scar appearance. The chemical composition of the wear scar surface was examined with X-ray photoelectron spectroscopy in conjunction with argon ion sputter etching. In severe wear scars, a sulfide was formed at the expense of the normal oxide layer. In mild wear scars, there were only superficial sulfur compounds, but there was a substantial increase in the oxide thickness. Author

N77-22217# Oak Ridge National Lab., Tenn.
IRON AND NICKEL CARBONYL FORMATION IN STEEL PIPES AND ITS PREVENTION: LITERATURE SURVEY
J. Brynestad Sep. 1976 20 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5499) Avail: NTIS HC A02/MF A01

The data demonstrate that carbonyl formation in steel pipes is governed largely by kinetics. The rate of carbonyl formation is a function of several factors: temperature, pressure, gas flow rate, gas composition, impurities in the gas, alloy composition, surface conditions, and pretreatment of the surfaces. An evaluation of techniques for detecting iron and nickel carbonyls in gases showed atomic absorption spectroscopy to be a highly effective, almost instantaneous analytical technique. Carbonyl formation in pipe steels is prevented mainly by the use of steels with high chromium contents, by lining the tubing with copper, or by use of any stable coating that prevents the carbon monoxide from directly contacting the metal. ERA

N77-22218# Utah Univ., Salt Lake City.
POSITRON LIFETIME MEASUREMENTS AS A NON-DESTRUCTIVE TECHNIQUE TO MONITOR FATIGUE DAMAGE Technical Progress Report
J. G. Byrne Sep. 1976 68 p refs
(Contract E(11-1)-2128)
(COO-2128-12) Avail: NTIS HC A04/MF A01

In hardened steel, hydrogen charging produces damage at martensite plate and lath surfaces; the damage as revealed by transmission electron microscopy was in the form of small voids. No similar particle interface damage was found in charged steel of a pearlitic microstructure; however, dislocation density increases were noted in both pearlitic and martensitic materials as a result of hydrogen charging. Additional irradiations and annealings revealed that stage 3 annealing of electron irradiated copper involves the motion and removal of both monovacancies and divacancies. A multivacany unit exists as a stable entity even after annealing above the stage 3 region. The fatigue studies of copper are developing a more full picture of dynamical hardening and softening at a number of intermediate conditions between the extremes of the fully annealed and cold worked conditions.

A critical point was discovered during early fatigue hardening, namely, the intensity of the primary lifetime starts dropping while that of the second lifetime increases. ERA

N77-22219# Energy Research and Development Administration, Washington, D.C.

CO2 INSERTION REACTION WITH ALUMINUM, GALLIUM AND INDIUM COMPOUNDS

Johann Weidlein 1970 14 p refs Transl. into ENGLISH from Zeit. Anorg. Allg. Chem. (Leipzig), Vol. 376-378, 1970 p 245-262

(RFP-Trans-170) Avail: NTIS HC A02/MF A01

Only dimeric dialkylmetal carboxylates are formed in the case of Ga and In; trimetric and more highly associated oligomers can be isolated with Al. Dimeric (with Al also trimeric) molecules are the sole products of reaction of the trialkyls (or their addition compounds with ether) with the amount of pure carboxylic acid calculated for exchange of one alkyl group for a RCOO-group. The vibrational spectra (IR and Raman) of the dimeric dialky carboxylates of Al, Ga, and In point to 8-membered ring skeletons (M2O4C2), presumably with only slight undulation. Halogen-' substituted organoaluminum, gallium, and indium compounds do not react with CO2. Author (ERA)

N77-22220# California Univ., Berkeley. Lawrence Berkeley Lab.

MICROSTRUCTURE OF A BASE METAL THICK FILM SYSTEM

D. E. Mentley Jun. 1976 36 p refs

(Contract W-7405-eng-48)

(LBL-5176) Avail: NTIS HC A03/MF A01

A base metal thick film conductor system using glass frits with base metal oxide additions was investigated as metallization for hybrid microcircuits. The observation of changes in the properties of the thick film was made by photomicrographs of screened samples and sheet resistivity measurements. In addition to the chemical and wetting properties, the effect of glass frit particle size on conductivity was also analyzed. The base metal oxide addition was found to produce a more consistent thick film conductor at low volume percentages of metal by inhibiting the formation of low melting redox reaction products. ERA

N77-22221# California Univ., Berkeley. Lawrence Berkeley Lab.

QUENCH-AGE METHOD FOR THE FABRICATION OF Nb(Al) SUPERCONDUCTORS

R. L. Ciardella (Hewlett-Packard, San Diego, Calif.), M. P. Dariel (Ben-Gurion Univ. of the Negev, Beer-Sheva, Israel), J. L. F. Wang, and M. R. Pickus Aug. 1976 5 p refs

(Contract W-7405-eng-48)

(LBL-4953; Conf-760829-40) Avail: NTIS HC A02/MF A01

The possibility of taking advantage of the extended, high temperature solid solubility of Al in Nb in order to produce composite Nb-Nb3Al superconductors was investigated. Rapid quenching after an elevated (1950 C) solution treatment makes it possible to retain at room temperature a metastable solid solution containing up to 21 at. percent Al. The solid solution transforms into the A-15 phase in the course of a short and relatively low temperature (1000 C) aging treatment. The inductively measured onset of superconductivity was 17.6 K in a 100 micrometer thick core of Nb3Al embedded in a Nb matrix and prepared by the quench-age method. ERA

N77-22222# California Univ., Livermore. Lawrence Livermore Lab.

INDUSTRIAL PRODUCTION OF LITHIUM METAL: REVIEW OF LITERATURE

Robert V. Homsy 2 Sep. 1976 15 p refs

(Contract W-7405-eng-48)

(UCRL-52124) Avail: NTIS HC A02/MF A01

A literature search uncovered operating conditions for industrial production of metallic lithium. Energy efficiency ranged from 9 to 41 percent, while maximum electrical energy efficiency of nearly 50 percent occurred at a current density of 4 kA/sq m. Main causes of inefficiency were ohmic potential drop in the electrolyte and heating energy loss. Alternate methods of producing lithium metal are also reviewed. ERA

N77-22223# Cornell Univ., Ithaca, N.Y. Dept. of Materials Science and Engineering.

MECHANICAL PROPERTIES OF CRYSTALLINE SOLIDS Progress Report, 1 Dec. 1975 - 30 Nov. 1976

Che-Yu Li 27 Aug. 1976 46 p refs

(Contract E(11-1-2172)

(COO-2172-15) Avail: NTIS HC A03/MF A01

A model for non-elastic deformation in the grain matrix based on a mechanical equation of state was verified by comparing the predictions of the model with experimental data. Data on Type 316 stainless steel and nickel were obtained in load relaxation and anelasticity tests. The same model was found to be successful in describing in-reactor creep and deformation. An investigation of the driving force and the kinetics of stress induced cavity growth at the grain boundary were also initiated. ERA

N77-22224# Hanford Engineering Development Lab., Richland, Wash.

FATIGUE-CRACK PROPAGATION BEHAVIOR OF INCONEL 600

Lee A. James May 1976 25 p refs

(Contract E(45-1)-2170)

(HEDL-TME-76-43) Avail: NTIS HC A02/MF A01

The techniques of linear-elastic fracture mechanics were employed to characterize the effects of several parameters upon the fatigue crack propagation behavior of Inconel 600. The parameters studied included temperature, cyclic frequency, stress ratio, thermal aging, and a limited amount of testing in a liquid sodium environment. ERA

N77-22225# Iowa State Univ. of Science and Technology, Ames. Rare-Earth Information Center.

COMMERCIAL RARE EARTH METALS AND ALLOYS COVERED BY THE UNIFIED NUMBERING SYSTEM (UNS)

J. A. Gschneider, Jr. Jul. 1976 15 p refs

(Contract W-7405-eng-82)

(IS-RIC-8) Avail: NTIS HC A02/MF A01

The scheme of the UNS system is an alpha-numeric code consisting of a single letter followed by five digits. The initial letter in the UNS indicates broad categories of alloys; A indicates aluminum alloys, C copper alloys, E earth and rare earth-like metals, L low-melting alloys, and so on. The UNS provides a means of correlating many number systems currently administered by societies, trade associations, and individual users and producers of metals and alloys. UNS also allows for the addition of new metals and alloys as they are introduced. In addition, the proposed system is readily adapted to computer listings for indexing purposes. ERA

N77-22226# Oak Ridge National Lab., Tenn.

INFLUENCE OF HEAT TREATMENT ON THE MICROSTRUCTURE AND MECHANICAL PROPERTIES OF STEEL WITH 2.25 PERCENT Cr AND 1 PERCENT Mo

Tasilo Prnka, Jaroslav Purmenskii, and Anna Jakoabova 1971 21 p refs Transl. into ENGLISH from Hutnicke Listy (Czechoslovakia), no. 26, 1971 p 51-58 Sponsored by ERDA

(ORNL-tr-4215) Avail: NTIS HC A02/MF A01

It was found that after quenching, Mo2C carbides up to about 1000 A in length precipitated. During tempering, the carbides break into shorter pieces. In steels of higher carbon content, a tempering range of 740 to 780 C is recommendad to produce ductile, high strength materials. ERA

N77-22227# Dartmouth Coll., Hanover, N.H. Dept. of Physics.

ANISOTROPIC QUASIPARTICLE PROPERTIES IN ALUMINUM

A. B. Meador and W. E. Lawrence Oct. 1976 38 p

(Contract EY-76-S-02-2315)

(COO-2315-8) Avail: NTIS HC A03/MF A01

The electron-phonon interaction in aluminum was studied using Fermi-fitted 4-OPW electron states, a realistic photon spectrum, and integration mesh-density varying with local Fermi surface curvature. The resulting electron mass enhancement lambda and thermal scattering rate are evaluated as functions of position on the Fermi surface. It was found that the agreement between observed and calculated cyclotron masses is improved by the use of an anisotropic effective mass enhancement lambda

rather than the average one. The anisotropy of lambda is determined predominantly by mixing coefficient variations, rather than by phonon anisotropy. The scattering rate exhibits order-of-magnitude variations over the Fermi surface at low temperatures. Its values at 5K are within 50% of the experimentally observed ones everywhere, with better agreement in free-electron regions. In free-electron regions, umklapp processes cause a more rapid increase than T sub 3 for temperatures above 15 to 25 K. ERA

N77-22228# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
EXPERIMENTS IN HIGH VOLTAGE ELECTRON MICROSCOPY Progress Report, 31 Oct. 1975 - Aug. 1976
T. E. Mitchell, G. Das, R. Barnard, and D. Ro Aug. 1976 17 p refs
(Contract E(11-1)-2119)
(COO-2119-17) Avail: NTIS HC A02/MF A01

High voltage electron microscopy is being used to study the effects of irradiation on a variety of materials. The vacancies and intenstitials produced by displacement can agglomerate to form dislocation loops and voids, annihilate at sinks, or enhance various diffusion processes such as precipitation and recrystallization. Threshold displacement energies, E/sub d/, were determined for a number of fcc, bcc, and hcp metals. Directions for minimum E/sub d/ were correlated with the crystal structure and the magnitude of E/sub d/ was related to the sublimation energy. The effects of electron irradiation on precipitation in Al-Cu, Al-Si, and Ni-Al alloys were investigated. Results on radiation damage in oxides (quartz, alumina, and magnesia) were also obtained. Displacement damage gives rise to dislocation loop nucleation and growth in all cases, including multilayer loops in Al2O3. ERA

N77-22229# Carnegie-Mellon Univ., Pittsburgh, Pa.
GENERALIZATION OF INTERNATIONAL CENTRIFUGAL ZONE GROWTH OF METAL-CERAMIC COMPOSITES Progress Report, 1 Dec. 1975 - 30 Nov. 1976
Robert F. Sekerka and Robert F. Hartzell Aug. 1976 10 p
(Contract E(11-1)-2407)
(COO-2407-5) Avail: NTIS HC A02/MF A01

One dimensional models for (hypothetical) infinitely large samples heated by long RF induction coils were developed. An S-curve instability phenomenon associated with spontaneous coupling of the RF field to materials whose electrical conductivity increases significantly with temperature was predicted. This model was extended to two dimensions to account for finite samples and coils. One-dimensional modeling was used in predicting additional instabilities (S shaped with a cusp) on melting which are 'piggy-back' with the S-curve instabilities at lower temperatures. The low temperature S instability was demonstrated for silicon. The predictive capacities of the modeling were used to engineer around instabilities in the CrO3-Mo systems and to extend internal centrifugal zone growth to a number of other materials. ERA

N77-22230# Ames Lab., Iowa.
EFFECT OF A HYDROGEN ENVIRONMENT ON THE CREEP PROPERTIES OF POLYCRYSTALLINE VANADIUM METALS M.S. Thesis - Iowa State Univ.
David Jansen Franklin Oct. 1976 59 p refs
(Contract W-7405-eng-82)
(IS-T-722) Avail: NTIS HC A04/MF A01

The creep behavior of pure polycrystalline vanadium tested in a dynamic vacuum environment was characterized, and any variation from its vacuum creep behavior brought about by exposure to hydrogen during creep was defined. Vanadium stops creeping immediately when hydrogen gas is admitted to the test chamber, at least under certain conditions. After 50 to 150 hours elapsed, vanadium assumed a creep rate which was somewhat less than the original very high vacuum (VHV) creep rate observed before the hydrogen was admitted. If the hydrogen gas is removed, a creep rate approximately equal to the VHV creep rate is observed after steady creep is reestablished. ERA

N77-22231# Oak Ridge National Lab., Tenn.
HEAVY-SECTION STEEL TECHNOLOGY PROGRAM Quarterly Progress Report, Apr. - Jun. 1976
G. D. Whitman 28 Sep. 1976 105 p refs
(Contract W-7405-eng-26)
(ORNL-NUREG-TM-49) Avail: NTIS HC A06/MF A01

Fracture mechanics, effects of water on crack growth in reactor vessel steel, radiation effects on reactor steels, pressure vessel investigations, and thermal shock investigations are discussed. Author (ERA)

N77-22232# Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
DEFORMATION PROCESSES IN REFRACTORY METALS Progress Report, 1 Dec. 1975 - 30 Nov. 1976
R. W. Arey, F. Boratto, D. E. Wise, P. G. Watson, and R. E. Reed-Hill 1976 73 p refs
(Contract E(40-1)-3262)
(ORO-3262-46) Avail: NTIS HC A04/MF A01

Internal friction determinations of the diffusion coefficients of O and N in niobium and re-evaluetion of the available relevant data in the literature are presented. The static strain-aging in Ti is reported. The effects of hydrogen on the yield point phenomena in niobium at the temperatures 273 and 193 K are presented along with transmission electron microscopy work on titanium aimed at obtaining a better insight into the causes of anomalous work hardening associated with dynamic strain-aging in this metal. ERA

N77-22233# California Univ., Livermore. Lawrence Livermore Lab.
EFFECT OF MACHINING DAMAGE ON TENSILE PROPERTIES OF BERYLLIUM
James E. Hanafee 20 Sep. 1976 7 p
(Contract W-7405-eng-48)
(UCID-17248) Avail: NTIS HC A02/MF A01

Tensile tests were conducted to illustrate that machining operations lower beryllium's mechanical properties. The importance of controlling machining damage in a particular grade of powder processed beryllium was quantitatively illuminated. S.M.

N77-22234# Battelle Pacific Northwest Labs., Richland, Wash.
REFRACTORY METALS FABRICATION TECHNOLOGY AS APPLIED TO FUSION REACTORS
Jul. 1976 283 p refs
(Contract E(45-1)-1830)
(BNWL-2053) Avail: NTIS HC A13/MF A01

Activites are reported in research programs on inspection and fabrication of refractory metals and alloys including those of Mo, Nb, Ta, and V. Progress is summarized in sections on blanking, edge preparation, machining, forming, joining, cleaning, thermal processing, and coating. ERA

N77-22235# Oak Ridge National Lab., Tenn.
EFFECT OF A HIGH HEAT FLUX ON THE CORROSION OF 2 1/4 Cr
J. C. Griess, J. H. DeVan (NUS Corp., Clearwater, Fla.), and W. A. Maxwell Oct. 1976 32 p refs
(Contract W-7405-eng-26)
(ORNL-TM-5551) Avail: NTIS HC A03/MF A01

A series of corrosion tests was conducted to determine the effect of heat flux on the corrosion of 2 1/4 Cr-1 Mo steel in superheated steam under conditions approaching those that will exist in the superheaters of the Clinch River Breeder Reactor Plant. The tests were conducted with a constant heat flux of 126 kW/sq m and surface temperatures varying from 510 to 541 C on each specimen. Specimens were exposed for varying lengths of time, ranging from 500 to 6,000 h. Essentially all the corrosion product oxide remained on the steel during the first 2,000 h, but after that time, exfoliation of the oxide began. The percentage of oxide lost from the specimen increased with exposure time; about 33 percent was missing after 6,000 h. After an initial period of rapid corrosion, the average corrosion rate was constant at 45 micrometers/year. ERA

N77-22236# Sandia Labs., Albuquerque, N.Mex.
RESISTANCE INCREASES IN GOLD ALUMINUM INTERCONNECTS WITH TIME AND TEMPERATURE
D. W. Bushmire Sep. 1976 13 p refs
(Contract E(29-1)-789)
(SAND-76-0381) Avail: NTIS HC A02/MF A01

Aluminum wire was ultrasonically bonded to Cr-Au and

TiPd-Au thin-film metallization on ceramic substrates. The interconnects were exposed to temperatures from 150 to 300 C and times up to 400 hours. The resistance of the interconnects was measured periodically during the exposure to elevated temperatures. There were significant increases of resistance on both types of metallization. Some measurements indicated electrically open interconnects, but the mechanical strength remained high. If systems containing gold aluminum interconnects are anticipated to be processed or used at or above 150 C, serious consideration should be given to the effects of increased resistance on circuit performance. ERA

N77-22237# Hanford Engineering Development Lab., Richland, Wash.

VOID-GAMMA PRIME PRECIPITATE INTERACTIONS IN EXPERIMENTAL NICKEL-BASE SUPERALLOYS

D. S. Gelles, M. K. Korenko, and L. E. Thomas Jan. 1976 19 p Presented at Ann. Meeting of AIME, Las Vegas, Nev., 22 Feb. 1976

(Contract E(45-1)-2170)

(HEDL-SA-807; Conf-760203-7) Avail: NTIS HC A02/MF A01

The process of radioinduced void swelling in Ni-base superalloys was investigated. Irradiation specimens having the following compositions were used: Ni-14Cr-1Al-3.5Ti, Ni-14Cr-1Al-3.5Ti-8Mo, Ni-14Cr-4.5Al, Ni-14Cr-4.5Al-2Mo, and Ni-14Cr-4.5Al-8Mo. These alloys represent the full available range of gamma prime/gamma precipitate mismatch used to control alloy coherency strengthening. Author (ERA)

N77-22238# Liverpool Univ. (England). Dept. of Metallurgy and Materials Science.

HOT CORROSION OF HIGH TEMPERATURE ALLOYS Final Scientific Report, 15 May 1972 - 14 May 1975

John Stringer 20 Aug. 1976 51 p refs Presented at Electrochem. Soc. Symp. on Properties of High Temp. Alloys, Las Vegas, Oct. 1976 Sponsored in part by European Office of Aerospace Res. and Develop., London

(Grant AF-AFOSR-2388-72)

(AD-A031363; EOARD-TR-76-05) Avail: NTIS HC A04/MF A01 CSCL 11/6

Hot corrosion is a form of accelerated oxidation of alloys which can occur in combustion gases in the presence of impurities. The characteristics of the reaction are defined by describing practical examples, and then the results of a variety of laboratory experiments are considered in relation to the practical process. The temperature dependence and kinetics of the corrosion are briefly presented, and the effect of alloying elements is discussed; high chromium contents are required for good corrosion resistance, but there is no general agreement on the effect of other alloy elements. A number of mechanisms for hot corrosion is described and discussed in relation to the practical results. GRA

N77-22239# Hitchcock Industries, Inc., Minneapolis, Minn.

DEVELOPMENT PROGRAM FOR IMPROVING FOUNDRY AND REPAIR WELDING TECHNIQUES FOR ZE41-TYPE MAGNESIUM ALLOY CASTINGS Final Report, Jul. 1975 - Jun. 1976

Jaydev Desai Sep. 1976 60 p refs

(Contract DAAA25-75-C-0599)

(AD-A031678) Avail: NTIS HC A04/MF A01 CSCL 11/6

This report describes a development program for improved foundry and repair welding techniques for large complex ZE 41-type magnesium castings, such as currently specified by the designers of next generation of army aircraft E.g. the AAH, UTTAS, etc. This one year program was directed at resolving the weld cracking problem in ZE 41 magnesium alloy combiner housing casting for the HLH aircraft, and making it a high quality reproducible part. The results on one HLH combiner housing casting poured with a chemical composition between that of EZ 33 and ZE 41 alloys, showed that the tensile properties of the machined test bars taken from various section thicknesses and chill/riser/neutral locations were similar, and that the tensile properties of welded and nonwelded areas were comparable. Two step heat treatment 625 for 675 F for two (2) hours, air cool, 340 F for twelve (12) hours provided effective stress relief. Thus for large complicated magnesium castings, such as the HLH combiner housing, the cracking in the weld areas during welding, as well as delayed cracking in the weld areas can be overcome by the proper selection of chemical composition and heat treatment. Author (GRA)

N77-22240# Battelle Columbus Labs., Ohio.

STUDY OF INTERMETALLIC COMPOUNDS TASK A: DISPERSION-HARDENED TiAl Interim Technical Report, 17 Feb. 1975 - 16 Feb. 1976

I. G. Wright and A. H. Clauer Wright-Patterson AFB, Ohio AFML Jul. 1976 49 p refs

(Contract F33615-75-C-1168)

(AD-A032012; AFML-TR-76-107) Avail: NTIS HC A03/MF A01 CSCL 11/6

The feasibility of increasing the high-temperature tensile and creep strength, the high-temperature oxidation resistance, and the low temperature ductility of the titanium aluminide, TiAl, by means of a dispersion of inert particles of yttria, has been studied. Alloys containing 1.5 and 3 volume percent Y2O3 were produced by attritor milling of TiAl and Y2O3 powders and hot extruding to bar stock. The major findings of the study are: (1) Attritor milling of TiAl powders for total milling times in excess of 100 hrs can be accomplished without problems. Milling for more than 80 hrs was required to achieve a uniform dispersion of yttria with the REP powder used in this program. (2) The oxygen and nitrogen contents of TiAl increased with increasing attritor milling time. (3) The microstructures of the Y2O3-containing TiAl alloys comprised a predominantly basket-weave structure of gamma and lamellar alpha 2, with uniformly dispersed particles. (4) The yttria-containing alloys exhibited considerably increased tensile strength at room temperature and at 1652 F compared to yttria-free TiAl. (5) The tensile creep strengths of Y2O3-containing TiAl and Y2O3-free TiAl at 900 C were similar. (6) No effect was observed of the dispersoid on the room-temperature ductility of TiAl. (7) the oxidation behavior of the yttria-containing alloys was variable, some specimens oxidizing more slowly than the equivalent dispersion-free TiAl specimens, and most specimens exhibiting adherent scale. GRA

N77-22241# Battelle Columbus Labs., Ohio. Tactical Technology Center.

AMORPHOUS AND METASTABLE MATERIALS Final Report

Robert E. Maringer Sep. 1976 47 p refs

(Contract DAAH01-72-C-0982; ARPA Order 2209)

(AD-A032064; A-4744) Avail: NTIS HC A03/MF A01 CSCL 11/6

This report summarizes the state of the art of amorphous and metastable materials, and includes a brief review of some of the properties of these materials, methods for producing them, possible directions for exploitation, identification of 'roadblocks' to R and D, and recommendations for DoD action.Author (GRA)

N77-22242# Naval Postgraduate School, Monterey, Calif.

MICROSCOPIC INVESTIGATION OF INTERFACE CORROSION OF STEEL-ALUMINUM EXPLOSIVELY BONDED MATERIAL EXPOSED TO PERIODIC SEA WATER SPRAY M.S. Thesis

Michael Richard Keelean Sep. 1976 37 p refs

(AD-A032365) HC A03/MF A01 CSCL 11/6

An explosively bonded triclad consisting of 5456 aluminum, 1100 aluminum, and ASTM A516, Grade 55 steel is currently in use as a transition joint between steel hulls and aluminum superstructures on several military marine vehicles. This study examines some of the corrosion processes and product formations that take place when this joint is exposed to the marine atmosphere. Accelerated sea spray testing was performed in the laboratory to simulate in-service conditions with joint specimens receiving exposures of varying durations. A corrosion model is hypothesized and photomicrographs of the various exposed specimens are presented and discussed. Author (GRA)

N77-22243# Rock Island Arsenal, Ill. Thomas J. Rodman Lab.

PROPERTIES OF POWDER METALLURGY STEEL FORGINGS

Andrew Crowson, Richard J. Grandzol, and Ferrel E. Anderson May 1976 33 p refs

(DA Proj. 1T1-62105-AH-84)

(AD-A031811; RIA-R-TR-76-039) Avail: NTIS HC A03/MF A01 CSCL 11/6

The effects of processing variables on the mechanical properties of heat-treated powder metallurgy (P/M) steel forgings were determined. Three powders, AISI 4650, and modified AISI 4600 powders blended with graphite to yield 4640 composition, and AISI 4650 powder, were compacted into preforms and hot forged in a warm, closed die. Variables studied were: preform density, method of lubrication, preform sintering (time, temperature, and atmosphere), forging pressure (20 and 40 tsi) and temperature (1850F, 2000F, and 2200F), and forging ratio (0.85 and 0.95). Relationships between interconnected porosity and total porosity for the various preform densities were determined. High density compacts required higher sintering temperatures due to the restricted mobility of the reducing gases in the pores. Die wall lubrication was comparable to admixed lubrication, and it simplified powder mixing and preform sintering operations. GRA

N77-22244# Naval Ship Engineering Center, Hyattsville, Md.
PROPERTIES OF COMBINED ALUMINUM TEE EXTRUSION AND PLATE
Peter Witherell and Eugene Aronne Aug. 1976 102 p refs
(AD-A031490; NAVSEC-6114-142-76) Avail: NTIS HC A06/MF A01 CSCL 11/6

The design information contained in this report was developed primarily for use in the SES Design Computer Program of NAVSEC 6114P1. Its publication as a separate report provides ship structural designers with tabulated properties for small non-standard aluminum T extrusions acting in combination with aluminum plate. The T extrusions range from .5 - 9.5 lb/ft and plating is in standard thicknesses from 1/8 in. to 1 in. The extrusions are designed primarily for use as stiffeners in lightweight aluminum structures such as the SES. Since stiffener spacings are typically less than the 35t effective plating width normally used for design in aluminum, the report includes tables for 8 in., 10 in., 12 in., 14 in., and 16 in. effective widths in addition to 35t. Criteria for proportions of the T extrusions are presented in the discussion. GRA

N77-22245# Naval Ship Research and Development Center, Annapolis, Md. Materials Dept.
DETERMINATION OF PREFRACTURE FATIGUE DAMAGE Interim Report
Irvin R. Kramer Nov. 1976 46 p refs
(ZR0220101)
(AD-A033484; MAT-76-74) Avail: NTIS HC A03/MF A01 CSCL 11/6

The dislocation distribution as a function of depth was investigated on fatigued and unidirectionally strained specimens of 4130 steel, 2024 aluminum, as well as on single crystals of aluminum and silicon. Using x-ray line broadening together with the Berg-Barrett technique, it was shown that the excess dislocation density was much larger in the surface layer to a depth of about 100 micrometers than in the bulk. From the measurements of the initial permeability at high frequencies (10 kilohertz) it would also be inferred that the dislocation density was larger in the surface layer. Because acoustic emissions were found at very low stresses relative to the maximum stress during fatigue, it appears that this method cannot be used on ferromagnetic materials to detect fatigue damage. Author (GRA)

N77-22246# Titanium Metals Corp. of America, Toronto, Ohio. TIMET Div.
FORMABLE SHEET TITANIUM ALLOYS Final Technical Report, 1 Mar. 1974 - 15 Dec. 1975
G. Lenning Aug. 1976 188 p refs
(Contract F33615-74-C-5063)
(AD-A033187; AFML-TR-76-45) Avail: NTIS HC A09/MF A01 CSCL 11/6

The objectives of this program were to evaluate three promising experimental alloys by optimizing mill processing using formability, formageability, and uniformity and consistency of properties as the criteria. The three alloys (1) Ti-8V-7Cr-3Al-4Sn-1Zr, (2) Ti-8V-4Cr-2Mo-2Fe-3Al, and (3) Ti-15V-3Cr-3Al-3 3Sn were selected. The three mill processes examined were: (1) conventional cold strip processing, (2) conventional hot mill processing to plate followed by cold hand mill rolling to sheet, and (3) conventional hot mill processing. The materials from the two cold roll processes showed the better forming potential and were selected for extensive mechanical property and formability evaluation. All three alloys offer improved mechanical properties over those for existing titanium sheet alloy airframe materials. Further work is recommended for one or more of these alloys because of the combination of economy in formed parts and mechanical properties. GRA

N77-22247# Washington State Univ., Pullman. Shock Dynamics Lab.
KINETICS OF SHOCK-INDUCED PHASE TRANSITIONS Final Report
J. W. Swegle, G. E. Duvall, and J. J. Dick Jun. 1976 244 p refs
(Contract DAAG46-75-C-0035; DA Proj. 1W0-62105-A-661)
(AD-A031643; WSU-SOL-75-02; AMMRC-CTR-76-18) Avail: NTIS HC A11/MF A01 CSCL 20/4

A method is developed for performing and interpreting shock wave experiments in two-dimensional strain using a light gas gun. The experimental configuration consists of the impact of a projectile on a wedge whose impact face makes an angle alpha with the projectile impact face. The instrumentation consists of resistance wires stretched parallel to and offset from the wedge rear surface in order to detect free surface motion. The system has the capability of making measurements over a continuous range of shock propagation distances in a single experiment. The repeatability of the technique is good to within three to four percent. The analytical technique consists of a Lagrangian finite-difference code written specifically to handle wedge impact problems. It includes material strength, stress relaxation, and phase transitions. Experiments were done on aluminum wedges and on iron and KC1 wedges shocked past their transition points. Comparisons with computer calculations of the problems show excellent agreement. GRA

N77-22248# California Univ., Los Angeles. School of Engineering and Applied Science.
SYNTHESIS OF NEW SUPERHARD MATERIALS AND THEIR APPLICATION TO CUTTING TOOLS Semiannual Technical Report, 1 Oct. 1975 - 31 Mar. 1976
R. F. Bunshah and A. H. Shabaik Apr. 1976 46 p refs
(Contract F44620-74-C-0044; ARPA Order 2574)
(AD-A032856; UCLA-ENG-7659; AFOSR-76-1195TR; SATR-4)
Avail: NTIS HC A03/MF A01 CSCL 11/2

The process of Activated Reactive Evaporation is used to synthesize superhard materials like carbides, oxides, nitrides and ultrafine grain cermets. The deposits are characterized by hardness, microstructure, microprobe analysis for chemistry and lattice parameter measurements. The synthesis and characterization of TiC-Ni cermets and Al2O3 are given. High speed steel tools coated with TiC, TiC-Ni and TaC are tested for machining performance at different speeds and feeds. The machining evaluation and the selection of coatings is based on the rate of deterioration of the coating tool temperature, and cutting forces. Tool life tests show coated high speed steel tools having 150 to 300 percent improvement in tool life compared to uncoated tools. Variability in the quality of the ground edge on high speed steel inserts produces a great scatter in the machining evaluation data. Author (GRA)

N77-22249# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
POWDER METALLURGY OF RANEY NICKEL
Stephen A. OHare, William L. Brien, Robert B. Worthington, and James E. Mauser Oct. 1976 18 p refs
(PB-261334/7; BM-RI-8182) Avail: NTIS HC A02/MF A01 CSCL 13H

The typical angular particle shape, in conjunction with aluminum present in a eutectic phase, facilitated interlocking leading to excellent green strength after compaction. Density and porosity as influenced by the compacting pressure were studied over the range of 37.5 to 207 MN/sq m. Sintering in an inert atmosphere from 575 to 850C caused a volume increase which is attributed to a solid state reaction between Al and Ni sub 2 Al sub 3 phases. The reaction is: 3Al + Ni sub 2 Al sub 3 yields 2Ni Al sub 3. A thermal pretreatment of 70 hours

at 700C was required to prevent this reaction from occurring during sintering. GRA

N77-22250# Solar, San Diego, Calif.
CONTROLLED COMPOSITION REACTION SINTERING PROCESS FOR PRODUCTION OF MCrAlY COATINGS Final Report, 11 Jul. - 15 Dec. 1975
W. G. Stevens and A. R. Stetson Aug. 1976 60 p refs
(Contract F33615-75-C-5268)
(AD-A032554; RDR-1802-6; AFML-TR-76-91) Avail: NTIS HC A04/MF A01 CSCL 11/3

The feasibility of the fluidized bed-controlled composition reaction sintering process for depositing sulfidation resistant and ductile CoNiCrAlY coatings on simple blade shapes of nickel-based superalloys has been demonstrated. Critical process parameters of all steps in the process have been identified. Methods were developed for adjusting the coating composition to emphasize either the chemical or mechanical properties of these coatings. Author (GRA)

N77-22251# Southwest Research Inst., San Antonio, Tex.
EVALUATION OF COATINGS FOR AIR/FLUID ACCUMULATORS
R. D. Brown and H. C. Burghard, Jr. 23 Sep. 1976 149 p refs
(Contracts N00156-74-C-1660; NAEC-ENG-7884)
(AD-A033295; SwRI-RS-634) Avail: NTIS HC A07/MF A01

This report describes a sequential two-phase evaluation of the corrosion and wear resistance of ten coatings on AISI 4130 steel under conditions simulating those present in catapult accumulators and arresting gear accumulators used on aircraft carriers. In Phase I, ten coatings were subjected to wear tests and short-term corrosion tests. Five of the coatings were selected for additional evaluation in Phase II which included continued corrosion tests, wear tests and mechanical properties tests. The best overall performance was exhibited by Tribaloy 800 which appears to be the most promising coating for protection of both catapult and arresting gear accumulators. Other coatings which appeared satisfactory were, in order of decreasing effectiveness, Nedox and Selectron Ni-Co for use in the catapult accumulator and Selectron Ni-W and Nedox in the arresting gear accumulator. A Nylon 11 coating was unsatisfactory because of coating blistering in corrosion tests in both hydraulic fluids and in the simulated arresting gear wear tests. Author (GRA)

N77-22252# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
EFFECT OF COPPER AND TIN ON MECHANICAL PROPERTIES OF HOT-ROLLED 0.2 Wt-Pct CARBON STEELS Report of Investigations 1976
Mark I. Copeland, John S. Howe, and James C. Sarvis Oct. 1976 30 p refs
(PB-261338/8; BM-RI-8183) Avail: NTIS HC A03/MF A1 CSCL 11F

Wrought steels containing 0.2 wt-pct C and up to 0.2 and 1.0 wt-pct Sn and Cu, respectively, were made and evaluated by conducting tensile and impact tests. Electron beam microprobe tensile properties of steel at different copper contents in the hot-rolled condition are described. Tin lowered the copper content at which strengthening by copper precipitation normally starts, 0.8 wt-pct, and decreased the strength of steel aged at 1,022F (550C). The most adverse effect of tin was lowering the notch toughness of steels at most copper contents. GRA

N77-22253# Columbia Univ., New York. Dept. of Chemistry.
PROJECT LABSTAR: STUDY OF THE FORMATION AND STRUCTURE OF EXCITED HIGH-TEMPERATURE METAL COMPOUNDS Final Report, 1 Apr. 1973 - 31 Mar. 1976
Richard N. Zare Mar. 1976 8 p refs
(Grant DA-ARO(D)-31-124-73-G147)
(AD-A033519) Avail: NTIS HC A02/MF A01 CSCL 07/4

The chemiluminescent reactions of metal atoms with various oxidizer gases had been investigated under single-collision conditions using a beam-plus-gas experimental arrangement. From these studies we have established new ground state dissociation energy for CAO, SRO, BAO, PBO, EUO, EUF, SMO and SMF. Much of the interest associated with these reactions is the possibility of constructing a chemically-driven short-wavelength laser. For this purpose, lifetime measurements of various excited states were made and the probability of producing an excited molecule for each molecule of reactant consumed was determined. It was found for all the systems investigated that the initial yield of excited-state products is very low, on the order of 1% or less. This suggests that secondary collisions of vibrationally 'hot' products may play an important role in causing the high excited-state yields observed in the torr pressure regime. Author (GRA)

N77-22254# Army Materials and Mechanics Research Center, Watertown, Mass.
CORROSION FATIGUE BEHAVIOR OF COATED 4340 STEEL FOR BLADE RETENTION BOLTS OF THE AH-1G HELICOPTER Final Report
Milton Levy and Joseph L. Morrossi Oct. 1976 15 p refs
(AD-A033253; AMMRC-TR-76-34) Avail: NTIS HC A02/MF A01 CSCL 01/3

The main rotor blade bolt for the 540 helicopter rotor system of the AH-1G, UH-1C, and UH-1M helicopters is proposed to be improved by substituting plasma-sprayed tungsten carbide coating on the outer shank of the 4340 steel bolt for the present cadmium or chromium plate. This study was undertaken to determine the effects of these coating systems on the fatigue behavior of 4340 steel in environments likely to be encountered in service. Both axial tension-tension and rotating bending fatigue testing of coated specimens were carried out in air and in 3.5% NaCl solution. The NaCl environment causes reductions in fatigue strength of bare and coated 4340 steel. The severity of the degradation depends on the coating applied and the type of fatigue test utilized. Author (GRA)

N77-22255# Arizona Univ., Tucson.
ON SPECTROSCOPIC MODELING OF THE WATER MOLECULE Final Report
D. Rogovin and H. Tigelaar Kirtland AFB, N. Mex. AFWL Sep. 1976 62 p refs
(Contract F29601-74-A-0023)
(AD-A032448/3; AFWL-TR-75-84) Avail: NTIS HC A04/MF A01 CSCL 07/4

The validity of spectroscopic modeling techniques for describing the rotational structure of high lying rotational levels of light asymmetric rotors, such as water, is examined. Present techniques based on Watson's rotational Hamiltonian were found to be inadequate. Author (GRA)

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N77-22256*# Teledyne Microelectronics, Los Angeles, Calif.
A PARYLENE COATING PROCESS FOR HYBRID CIRCUITS
1976 24 p refs
(Contract NAS3-19144)
(NASA-CR-135071) Avail: NTIS HC A02/MF A01 CSCL 11G

The parylene coating process developed during this program consists of (1) obtaining a hybrid cover with a hole in it, (2) sealing of the circuit with a hole in the cover, (3) parylene coating through the hole with the external leads protected from parylene by appropriate fixturing, and (4) sealing of the hole by soldering a pretinned kovar tab. Development of the above process required optimization of the parylene coater parameters to obtain a uniform consistent coating which could offer adequate protection to the circuits, fixture design for packages of various types, determination of the size of the deposition hole, and the amount of dimer charge per run, a process to hermetically seal the deposition holes and establishment of quality control techniques or acceptance criteria for the deposited film. Author

N77-22257*# National Aeronautics and Space Administration. Pasadena Office, Calif.
DURABLE ANTISTATIC COATING FOR POLYMETHYL-

METHACRYLATE Patent Application
Vaclav Hadek (JPL), Alan Rembaum (JPL), and Robert B. Somoano, inventors (to NASA) (JPL) Filed 3 Jun. 1976 13 p (Contract NAS7-100)
(NASA-Case-NPO-13867-1; US-Patent-Appl-SN-692284) Avail: NTIS HC A02/MF A01 CSCL 11G

A durable antistatic coating was achieved on polymethyl methacrylate plastic without affecting its optical clarity by applying to the plastic surface a low molecular weight solvent having a high electron affinity and a high dipole moment. The solvents were acentonitrile, nitromethane, or photopolymerizable monomer. The treated polymethyl methacrylate plastic then dissipated most of the induced electrostatic charge and retained its optical clarity. The antistatic behavior persisted after washing, rubbing, and vacuum treatment. NASA

N77-22258# National Aerospace Lab., Tokyo (Japan).
APPLICATION OF MOIRE METHOD TO STRAIN ANALYSIS OF POLYMERS
Shinichi Koshide Sep. 1976 12 p refs In JAPANESE; ENGLISH summary
(NAL-TR-470) Avail: NTIS HC A02/MF A01

The mechanical properties of polymers are normally dependent on time and temperature. The stiffnesses of such materials are greatly affected by temperature. In the range above the glass transition temperature, polymers show viscoelastic behavior, become soft and greatly deformed. In the range below the temperature, however, the materials become as hard and brittle as glass. Employing the Moire method makes it possible to measure the large displacement of soft materials without the influence of temperature change or the reinforcing effect. Moreover, strain is easily analyzed by differentation of displacement. The method can be applied to the displacement or strain analysis of polymers in higher temperature ranges. As an example, the Moire method was applied to the analysis of creep strain, thermal strain, and residual strain of epoxy resins. The experimental results indicate that the thermomechanical property of epoxy rasins in each temperature range can be determined by the Moire fringe patterns, along with the strain obtained by the fringe patterns. Author

N77-22259# Bendix Corp., Kansas City, Mo.
SILICONE ELASTOMER EVALUATION FOR CABLE JACKET APPLICATION Final Report
R. R. Crockett Sep. 1976 21 p refs Revised
(Contract E(29-1)-613)
(BDX-613-1507-Rev) Avail: NTIS HC A02/MF A01

A silicone elastomer was found to be adequate for use as a cable jacket compound. The elastomer has room temperature physical properties approximately equal to those of the currently used neoprene jacket compound and permits functional operations at temperatures both above and below those of neoprene. ERA

N77-22260# Bendix Corp., Kansas City, Mo.
DYNAMIC RESPONSE OF RIGID POLYURETHANE FOAM
R. A. Daniel Sep. 1976 79 p refs
(Contract E(29-1)-613)
(BDX-613-1583-Rev) Avail: NTIS HC A05/MF A01

The dynamic characteristics of six rigid polyurethane foams were studied at impact velocities from 15.24 to 60.96 m/s (50 to 200 ft/s). A test technique developed for crushing confined samples is described. The dynamic properties of materials tested are reported by both graphical and tabular methods. ERA

N77-22261# California Univ., Berkeley. Lawrence Berkeley Lab.
CLASSICAL THEORY AND CALCULATIONS OF CIRCULAR DICHROISM IN INFINITE HELICAL POLYMERS Ph.D. Thesis
A. I. Levin Sep. 1976 224 p refs
(Contract W-7405-eng-48)
(LBL-5376) Avail: NTIS HC A10/MF A01

A theory of optical activity in helical polymers is derived. Helical symmetry and periodic boundary conditions are applied to classical polarizability theory in order to express the infinite polymer result in closed form. Result is all order in intermonomer interactions and gives the polymer circular dichroism bandshape in terms of monomer transition bandshapes. A complex unit of symmetry containing many optical transitions is also explicitly treated. ERA

N77-22262# Los Alamos Scientific Lab., N. Mex.
REDUCTION IN THERMAL CONDUCTIVITY OF CERAMICS DUE TO RADIATION DAMAGE
F. W. Clinard, Jr., G. F. Hurley, and F. W. Clinard, Jr. 1976 9 p refs Presented at 2nd Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, 21 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2090; Conf-760935-14) Avail: NTIS HC A02/MF A01

Ceramics are required for a number of applications in fusion reactors. In several of these applications, the thermal conductivity is an important design parameter as it affects the level of temperature and thermal stress in service. Ceramic insulators are known to suffer substantial reduction in thermal conductivity due to neutron irradiation damage. The reduction in thermal conductivity at high temperature due to radiation induced defects was estimated. Point, extended, and extended partly transparent defects are considered. ERA

N77-22263# Brookhaven National Lab., Upton, N.Y.
CONCRETE-POLYMER MATERIALS FOR GEOTHERMAL APPLICATIONS Progress Report, Oct. - Dec. 1975
1975 22 p refs
(Contract E(30-1)-16)
(BNL-20865; PR-7) Avail: NTIS HC A02/MF A01

The availability of durable and economic materials of construction for handling hot brine and steam is a serious problem in the development of geothermal energy. The standard grouting materials used to cement well casings into the ground are severely attacked by brine and steam at temperatures greater than 200 C. Progress in the research program to determine if concrete-polymer composite materials can be utilized in geothermal power systems, initiated in April 1974, is reported. Author (ERA)

N77-22264# California Univ., Livermore. Lawrence Livermore Lab.
EVALUATION OF EXISTING POLYMER CHARACTERIZATION TECHNIQUES AND CAPABILITIES OF THE GENERAL CHEMISTRY AND ORGANIC MATERIALS DIVISIONS IN THE CHEMISTRY AND MATERIALS SCIENCE DEPARTMENT
F. N. Larsen 25 Aug. 1976 18 p
(Contract W-7405-eng-48)
(UCID-17288) Avail: NTIS HC A02/MF A01

There were thirteen specific techniques including various spectroscopy, thermal, solutional properties, wet chemistry, chromatography and miscellaneous procedures evaluated. Comments and recommendations on the need for an analytical services focal point in GCD, a polymer characterization expert in OMD and the use of contractor facilities as a source of data gathering are made. Substantial capabilities for polymer characterization do exist, but lack of adequate interfacing between OMD and GCD is preventing their effective use. Acquisition of a polymer chemist with experience in characterization techniques appears to be the best solution to this problem. Author (ERA)

N77-22265# Bendix Corp., Kansas City, Mo.
INJECTION MOLDING THERMOPLASTIC RUBBER Final Report
J. R. Porter Aug. 1976 14 p Revised
(Contract E(29-1)-613)
(BDX-613-1485-Rev; PDO-6989259-Rev) Avail: NTIS HC A02/MF A01

Thermoplastic rubber molding compounds were investigated to determine the feasibility of using the material for certain configurations. Thermoplastic rubber is processed directly into finished products, using standard thermoplastic molding and extruding equipment. A series of material, all from the same manufacturer, was evaluated. The mold shrink factors, molding conditions, and possible applications for each series were evaluated. Molding parameters were established, and a relationship of these parameters to mold shrinkage was determined. The results indicated that the shrink factor depended on the series of material more than on the molding conditions. It was concluded

that thermoplastic rubber is processed in conventional thermoplastic equipment. ERA

N77-22266# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
A MICROSCOPIC MECHANISM FOR STEADY STATE INHOMOGENEOUS FLOW IN METAL GLASSES Interim Technical Report
Frans Spaepen Aug. 1976 35 p refs
(Contract N00014-67-A-0298-0036; Grant NSF DMR-72-03020)
(AD-A031626; TR-7) Avail: NTIS HC A03/MF A01 CSCL 11/6

An empirical deformation map for metallic glasses is introduced and the two modes of deformation, homogeneous and inhomogeneous flow, are reviewed. The microscopic mechanism for steady state inhomogeneous flow is based on a dynamic equilibrium between stress-driven creation and diffusional annihilation of structural disorder. The formalism is developed using the free volume as the order parameter. The boundary line between the homogeneous and inhomogeneous flow regions on the deformation map is calculated. The stress-strain relation in inhomogeneous flow approaches ideally plastic behavior. Author (GRA)

N77-22267# General Electric Co., Schenectady, N.Y.
IMPACT RESPONSE CHARACTERISTICS OF POLYMERIC MATERIALS Final Report, 1 May 1975 - 30 Apr. 1976
William B. Hillig Sep. 1976 94 p refs
(Contract N00019-75-C-0320)
(AD-A032077; SRD-76-112) Avail: NTIS HC A05/MF A01 CSCL 11/9

Stress relaxation and creep behavior of PC and PMMA were studied under conditions of constant velocity loading followed by halts. This information was used to deduce relaxation-corrected, force-incursion depth behavior. Measurements of force versus depth were also made on sinusoidally programmed indentation. The evaluation of the 'densified' zone forming under the contact area was followed cinematographically. Models were developed including one that leads to the time and velocity dependence of the stress relaxation. Author (GRA)

N77-22268# Westinghouse Research Labs., Pittsburgh, Pa.
TECHNIQUES FOR SURFACE WETTING OF NaK TO COPPER FOR LIQUID METAL SLIPRING HOMOPOLAR MACHINES
F. G. Arcella and R. E. Witkowski Nov. 1976 69 p refs
(Contract N000167-76-M-8066)
(AD-A031861; PAS-76-25) Avail: NTIS HC A04/MF A01 CSCL 11/7

High current density homopolar machines employing liquid metal sliprings require wetted surfaces to minimize power losses induced by contact resistance and to maximize fluid retention during machine operation. A literature review and evaluation were performed to determine which methods of establishing wetting of NaK to copper might be applicable to new naval propulsion machines. Requirements for these methods include that they be performed shipboard, in-situ, repeatably, at low temperatures, and with the least disruption to presently planned systems. Methods of measuring and establishing liquid metal wetting, as well as the theories of wetting, were reviewed. Several new approaches for establishing and maintaining wetting, within the naval machine constraints, were discovered. Two promising techniques recommended for development include small lithium additions to NaK and ultrasonic encouragement. Small scale cursory tests were positive for both techniques. A detailed experimental test plan, to fully develop and characterize these and other applicable wetting techniques, is presented. Author (GRA)

N77-22269# Monsanto Research Corp., Dayton, Ohio.
RESEARCH ON HEAT RESISTANT TRANSPARENT INTERLAYERS BASED ON THE ETHYLENE TERPOLYMER Final Report, 2 Jan. - 2 Dec. 1975
George L. Ball, III, Dennis W. Werkmeister, and Ival O. Salyer Aug. 1976 72 p refs
(Contract F33615-75-C-5090)
(AD-A033549; MRC-DA-533; AFML-TR-76-109) Avail: NTIS HC A04/MF A01 CSCL 11/10

An ethylene terpolymer aircraft glazing interlayer, designated ETAXXX032, was developed that has reasonable strength to 350 F while retaining excellent high elongation down to -65 F. The high temperature performance was achieved while retaining thermoplastic sheet formability at 250 F required for polycarbonate. The improved mechanical performance to 350 F introduced no changes in the basic (550 F) thermal stability or transparency of the ethylene terpolymer. Author (GRA)

N77-22270# Naval Air Development Center, Warminster, Pa. Air Vehicle Technology Dept.
ANTIWEAR ADDITIVES, WEAR STUDIES ON CHEMICAL ADDITION AGENTS FOR IMPARTING AN EFFECTIVE LUBRICATING RESPONSE IN POLYSILOXANE (SILICONE) FLUIDS Progress Report
James L. Hammond and Alfeo A. Conte, Jr. 2 Jul. 1976 56 p refs
(AD-A033527; NADC-76226-30) Avail: NTIS HC A04/MF A01 CSCL 11/8

An additive package based on chlorendate and thiadiazole molecular structures has been discovered which imparts antiwear properties to tetrachlorophenylmethyl siloxane fluids that have been previously unattainable. For the first time a polysiloxane based fluid possessing antiwear properties comparable to such outstanding lubricants as petroleum oils, synthetic hydrocarbons, diesters and phosphate esters was formulated. In addition, a detailed analysis of the modification of friction surfaces (steel-on-steel) using organophosphate addition agents in polysiloxane fluids has refuted the commonly held belief that the inability of antiwear additives to function in polysiloxane media at low concentrations is due to the fact that the additive is substantially excluded from the surface. Evidence is presented to show that additive-surface interactions are indeed prevalent resulting in an antagonistic (pro-wear) action. In one specific instance depending on load and concentration a beneficial lubricating response is achieved with a tetrachlorophenylmethyl siloxane fluid containing alkylphosphate derivatives. The use of organo-phosphates as antiwear agents in polysiloxane has previously proved unfruitful, therefore, these results represent a significant area for further study. GRA

N77-22271# Army Materials and Mechanics Research Center, Watertown, Mass.
SYNTHESIS AND BALLISTIC EVALUATION OF SELECTED TRANSPARENT POLYURETHANE BLOCK COPOLYMERS. PART 3: FURTHER EFFORTS TO OPTIMIZE BALLISTIC PERFORMANCE Final Report
Anthony F. Wilde, Richard W. Matton, Joseph M. Rogers, and Stanley E. Wentworth Sep. 1976 16 p refs
(DA Proj. 1T1-62105-AH-84)
(AD-A033023; AMMRC-TR-76-31-Pt-3) Avail: NTIS HC A02/MF A01 CSCL 11/9

In a continuation of previous work with polyurethane block copolymers for transparent armor application, further variations have been investigated in stoichiometry and type of monomer with regard to their effects upon ballistic performance (V(50)) of the resultant copolymer. For the copolymer composed of 2,4-toluene diisocyanate, polytetramethylene oxide, and 1,4-butanediol, variations in the soft segment/hard segment ratio have led to the composition which gives the highest V(50) value in this series. Attempts have been made to improve the V(50) by replacement of 1,4-butanediol with N,N-bis(2-hydroxypropyl) aniline, the substitution of xylylene diisocyanate for 2,4-toluene diisocyanate, the use of a variety of molecular weights of polytetramethylene oxide, and the incorporation of trimethylolpropane as a crosslinking agent. Correlations have been made between composition, specimen hardness, ballistic failure mode, and V(50) for the polyurethane block copolymers made from these materials. GRA

N77-22272# National Bureau of Standards, Washington, D. C. Inst. for Materials Research.
FRACTURE OF BRITTLE MATERIALS AT HIGH TEMPERATURE Final Report, 1 Oct. 1972 - 31 Dec. 1975
Shelly M. Wiederhorn Aug. 1976 20 p refs
(Contract F33615-73-M-6501)
(AD-A032656; AFML-TR-76-139) Avail: NTIS HC A02/MF A01 CSCL 11/2

To assure the reliability of silicon carbide and silicon nitride in turbine applications, their mechanical properties at high temperatures must be understood. Fracture properties are particularly important. Because the experimental techniques for the measurement of these properties had not yet been developed, at the start of this program, there existed little information on the fracture properties of silicon carbide and silicon nitride at high temperatures. This summary of work conducted at NBS over the past three years presents a considerable body of knowledge on these materials as a result of the improvement and development of new techniques of measurement. GRA

N77-22273# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Macromolecular Science.

THE EFFECT OF THE ENVIRONMENT ON THE MECHANICAL BEHAVIOR OF SEMI-CRYSTALLINE POLYMERS AT HIGH PRESSURES

S. Kapur and E. Baer 10 Nov. 1976 29 p refs

(Contracts N00014-75-C-0795; N00014-67-A-0404-0013)

(AD-A032741; TR-5) Avail: NTIS HC A03/MF A01 CSCL 11/9

The effect of a silicon oil environment on the mechanical behavior of the semicrystalline polymers polyethylene, polypropylene and polyoxymethylene, under conditions of superposed hydrostatic pressure have been studied. These studies show that silicon oil does not affect the modulus and yield stress of these polymers: thus the modulus and yield stress increase with pressure but stress-strain curves of samples exposed to the silicon oil and sealed from it coincide in this region. Silicon oil does however, affect both the mechanism and extent of plastic deformation occurring in these polymers. Thus, samples of polyethylene and polypropylene, which are exposed to the oil, show a transition in the mode of plastic deformation from neck formation and propagation at test pressures below 1 to 2 kbar to enhanced ductility, without strain hardening. Similar behavior is observed in polyoxymethylene but is less pronounced. In terms of morphology, this affect is suggested as possibly occurring due to lamellar slip facilitated by silicon oil, plasticized inter-lamellar regions, and further experiments are being undertaken to verify this. Author (GRA)

N77-22274# Lehigh Univ., Bethlehem, Pa. Materials Research Center.

INFLUENCE OF CROSSLINKING ON THE MECHANICAL PROPERTIES OF HIGH TG POLYMERS Final Report, May 1975 - Apr. 1976

John A. Manson, Leslie H. Sperling, and Soojaa L. Kim Jul. 1976 102 p refs

(Contract F33615-75-C-5167)

(AD-A033078; AFML-TR-76-124) Avail: NTIS HC A06/MF A01 CSCL 11/9

Research was begun on the effects of crosslinking on the mechanical properties of high-Tg polymers, with particular emphasis on the role of crosslink density, variations in the distribution of crosslink segment lengths, and the role of network imperfections. Two systems were selected: one based on the use of the Bamford synthesis to provide model, well defined networks, and the other based on the use of bisphenol-A-type epoxy/methylene dianiline resins synthesized to provide controlled variations in network properties. To date, the feasibility of varying network characteristics in a model system by introducing hydrolyzable or permanent crosslinks has been demonstrated using copolymers of styrene or ethyl acrylate with acrylic acid anhydride. The creep and stress relaxation behavior was found to reflect the characteristics of the networks. GRA

N77-22275# Materials Research Labs., Maribyrnong (Australia).

WEATHERING OF FILAMENT-WOUND GLASS-EPOXY TUBES

John G. Williams May 1976 25 p refs

(AD-A032859; MRL-R-662) Avail: NTIS HC A02/MF A01 CSCL 11/4

Filament-wound glass-epoxy tubes manufactured for use as a rocket-launcher component have been used to study weathering of unstressed composites in a hot-wet environment. Tubes were exposed in three forms: as wound; after grinding to a fixed diameter; and after coating with alkyd paint. Burst pressure and torsional rigidity tests were used to study the mechanical effects of degradation. No significant deterioration could be detected mechanically after exposure in an unstressed state for two years at JTRU Innisfail, North Queensland. Minor loss of superficial glass fibre was observed on ground, uncoated specimens, but this relatively small deterioration was prevented by the use of the standard coating system. (Author) GRA

N77-22276# North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.

THE BARRIER PROPERTIES OF POLYACRYLONITRILE

S. M. Allen, M. Fujii, V. Stannett, H. B. Hopfenberg, and J. L. Williams Nov. 1976 21 p refs

(Contract N00014-75-C-0629; NR Proj. 356-530)

(AD-A033353; TR-2) Avail: NTIS HC A02/MF A01 CSCL 11/9

The permeabilities and time lag diffusivities have been determined in machine cast polyacrylonitrile films for helium, neon, argon, krypton, oxygen, nitrogen and carbon dioxide. Removing the last traces of residual solvent caused a slight reduction in the values, but the activation energies were unchanged. Separate high pressure sorption measurements showed that dual mode sorption was taking place. The permeabilities were remarkably low. The ratios of the permeabilities of helium to the other gases is remarkably high. This, coupled with the rather low activation energies, suggests that one important reason for the excellent barrier properties of polyacrylonitrile is the very small size of the fluctuating free volume elements in this polymer. Author (GRA)

N77-22277# Asian Inst. of Tech., Bangkok (Thailand).

FERROCEMENT, A VERSATILE CONSTRUCTION MATERIAL: ITS INCREASING USE IN ASIA

Ricardo P. Pama, Seng-Lip Lee, and Noel D. Vietmeyer (Natl. Acad. of Sci., Washington, D. C.) 1976 114 p refs Presented at Proc. of Workshop on Introduction of Technol. in Asia-Ferrocement, Bangkok, Thailand, 5-8 Nov. 1974 Sponsored in part by Agency for Intern. Develop., Washington, D. C. and Natl. Acad. of Sci., Washington, D. C.

(PB-261818/9) Avail: NTIS HC A06/MF A01 CSCL 13C

The workshop's basic purposes were: (1) to survey both the state of the art of ferrocement technology and its applications important to Southeast Asia; (2) to provide information on ferrocement research and development taking place in Asia and to share the knowledge and experience gained thus far; (3) to discuss the most promising methods of introducing ferrocement technology to Asia from the point of view of effectiveness, cost, and social acceptability; (4) to recommend areas of technical and social research that need to be carried further with respect to ferrocement. Demonstrations of ferrocement construction were held during the workshop. GRA

N77-22278# Rockwell International Science Center, Thousand Oaks, Calif. Science Center.

FAILURE PREDICTION IN CERAMICS USING ULTRASONICS Technical Report, 1 Mar. - 31 Oct. 1976

A. G. Evans, B. R. Tittmann, and L. A. Ahlberg 17 Nov. 1976 45 p refs

(Contract N00014-76-C-0624)

(AD-A033004; SC5064.1TR) Avail: NTIS HC A03/MF A01 CSCL 11/2

The requirements for failure prediction in ceramics using ultrasonics have been examined. These show that the absolute prediction of failure at acceptable stress levels and lifetimes requires high frequencies, in the 50-400 MHz range. The ability to utilize such high frequencies for flaw detection studies is primarily dependent on the attenuation of the material in this frequency range. Attenuation studies performed on a variety of ceramic materials have shown that the coarse grained or porous ceramics are excessively attenuating, whereas the fine grained fully dense ceramics are acceptable. An analysis of attenuation using numerical scattering cross sections and microstructural parameters has demonstrated that the attenuation is entirely predictable from the large extreme of the microstructure. The analysis has also suggested that attenuation measurements may permit the implementation of statistical failure prediction at high levels of confidence, in materials that are not amenable to absolute failure prediction using high frequency ultrasonics. Author (GRA)

N77-22279# Texas A&M Univ., College Station. Mechanics and Materials Research Center.
A THEORY OF TIME-DEPENDENT BONDING FOR VISCOELASTIC MEDIA Interim Report
R. A. Schapery Jul. 1976 32 p refs
(Grant AF-AFOSR-2697-74; AF Proj. 9782)
(AD-A032827; MM-3064-76-4; AFOSR-76-1148TR) Avail: NTIS HC A03/MF A01 CSCL 11/9

A theory is developed for the prediction of time-dependent bonding of surfaces of similar or dissimilar linear viscoelastic materials. Starting with an extended correspondence principle, viscoelastic stresses and displacements in the neighborhood of a moving contact edge are derived. These results are then employed in a local energy balance which leads to an equation for predicting the rate of bonding as a function of the local displacement intensity factor. A comparison of true and apparent energies for bonding and fracture is made. Finally, criteria are given for determining whether or not bonding can occur, and then the prediction of the time required for complete bonding or healing of cracks is examined. This study will aid in the understanding and prediction of the very significant amount of time-dependent stiffening of polymeric composite materials which follows mechanical load-induced internal damage, as observed for example in solid propellant and tire tread rubber. GRA

N77-22280# National Bureau of Standards, Washington, D. C. Engineering Mechanics Section.
FAILURE ANALYSIS OF FIBERGLASS INSULATOR RODS Final Report
Leonard Mordfin and Nixon Halsey Jul. 1976 57 p refs
Sponsored by Coast Guard, Washington, D. C.
(PB-261965/8; NBSIR-76-1136) Avail: NTIS HC A04/MF A01 CSCL 09A

Failure analyses were carried out on a group of coated fiberglass-reinforced-plastic insulator rods that had sustained burn damage and loss of coating in service on a radar tower. The investigation included chemical, flammability, electrical, and mechanical tests as well as a variety of measurements and inspections. The burn damage, consisting chiefly of carbonaceous tracking and charring, was attributed primarily to the occurrence of electrical discharges, from the energized end fittings to the rods, under conditions in which the electrical leakage path resistance had been reduced by moisture from rain, fog, and ocean spray. The effects of this damage on the structural integrity of the rods were evaluated. GRA

N77-22281# Minnesota Univ., Minneapolis. Dept. of Aeronautics and Engineering Mechanics.
DAMPING IN PORCELAIN ENAMEL COATINGS Final Report, Aug. 1971 - Sep. 1974
Prabha Iyengar Sridharan Jul. 1976 224 p refs
(Contract F33615-72-C-1315)
(AD-A031774; AFML-TR-74-191) Avail: NTIS HC A10/MF A01 CSCL 11/2

Equipment was developed and tested which was used for measuring the complex elastic moduli of thin porcelain enamel coatings at temperatures where they became very soft. Previous work has been done in glasses, almost exclusively at relatively low temperatures, to measure the effects of ionic diffusion or other chemical activation changes or at high temperatures where one is dealing with a melt. Measurements from ten to the 2nd power to ten to the 12th power Poise have been conducted mainly for production control and have relied on standard tests. The present work shows how the storage and loss portions of the shear and Young's modulus can be measured directly as functions of temperature and frequency and proposes a general relation which depends only on the room temperature modulus, the activation energy, the critical temperature and one other parameter which gives the relaxation spectrum bandwidth.
Author (GRA)

N77-22282# Battelle Columbus Labs., Ohio.
HIGH TEMPERATURE CREEP OF CERAMICS Final Technical Report, 1 Feb. 1973 - 31 Jan. 1976
Martin S. Seltzer Wright-Patterson AFB, Ohio AFML Jun. 1976 69 p refs
(Contract F33615-73-C-4111)
(AD-A031766; AFML-TR-76-97) Avail: NTIS HC A05/MF A01 CSCL 11/2

Tensile and compression creep measurements were made on yttria-stabilized zirconia (YSZ), hot-pressed silicon nitride and silicon materials, in atmospheres including air, nitrogen, argon, and vacuum. For relatively fine-grained YSZ (below 40 microns), the 1.5 power of the applied stress at low stresses and with the stress cubed at high stresses were measured. Results for coarse grained specimens can generally be fitted by the cube dependence. Creep activation energies for YSZ are found to be 128 kcal/mole independent of yttria content, impurity level, grain size, and porosity distribution. For the silicon compounds, at least two different creep mechanisms are operative in the range of temperatures and stresses employed in this study. A grain boundary sliding mechanism, characterized by a stress dependence of two and an activation energy of 168 kcal/mole, appears to be operative for hot-pressed silicon nitride; but a viscous creep mechanism predominates for some SiAlON materials, where a linear stress dependence and an activation energy of 94 kcal/mole have been measured. Author (GRA)

N77-22283# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SILICA GROUTS
J. Baron Oct. 1976 28 p refs Transl. into ENGLISH from Assoc. Tech. de la Siderurgie (France), v. 31, no. 12, 1974 p 2579-2601
(AD-A032058; CRREL-TL-552) Avail: NTIS HC A03/MF A01 CSCL 11/2

Until recent years, the grouts used for cementing silica bricks had a quite different chemical composition and a mineralogical composition quite close to those of silica bricks. Indeed, they were prepared from baked finely ground silica bricks to which plastic clay was added in order to provide the grout with a certain ease in employment and allow ceramic setting at high temperature. The ternary SiO2-Al2O3-CaO diagram shows that these types of grouts have limiting temperatures of utilization incompatible with temperatures reached in modern coke furnaces. The grouts are therefore developed in the direction of purify (decrease in contents of CaO and Al2O3) and fineness in order for the ceramic setting to be reached at high temperature by sintering. The specifications relating to silica grouts are few in number and rather disparate. The tests carried out on about 20 silica grouts: mineralogical and particle-size analyses, pyroscopic strength, thermal expansion, settling tests under differential charge, and creep on sandwich test specimens have allowed specifying the limiting values of these different characteristics and can allow estimate of the quality of a given grout.
Author (GRA)

N77-22284# National Bureau of Standards, Washington, D. C. Engineering Mechanics Section.
FATIGUE AND WEATHERABILITY STUDIES OF ARAMID-FIBER ROPE SLINGS Final Report, Apr. - Dec. 1975
Nixon Halsey and Leonard Mordfin Sep. 1976 35 p refs
(PB-261994/8; NBSIR-76-1159) Avail: NTIS HC A03/MF A01 CSCL 01C

Tests were carried out on twenty-six sling-leg specimens, fabricated from aramid-fiber ropes, as part of a program to develop improved external cargo slings for helicopters. The ropes included both parallel-strand and cabled-strand varieties, in three different tensile capacities. The tests were intended to evaluate the reductions in rope strength caused by fatigue loading and by exposure to simulated weathering. The fatigue capabilities of some of the ropes are not entirely satisfactory; but, because of inadequacies in the end fittings installed by the rope manufacturers, thorough evaluations were not possible. GRA

N77-22285# Arizona Univ., Tucson. Dept. of Chemistry.
ELECTRICAL CONDUCTIVITY OF ION EXCHANGE RESINS
Gary D. Carmack and Henry Freiser 10 Dec. 1976 13 p refs
(Contract N00014-75-C-0400)
(AD-A033579; TR-5) Avail: NTIS HC A02/MF A01 CSCL 07/4

The electrical conductivity of Dowex-1 in the C1(-), Br(-), I(-) and N03(-) forms has been determined at pressures ranging up to 2000 atmospheres. Activation volumes for the conduction process closely match the crystallographic volumes of the anions.

The data sheds light on the conduction mechanism in ion selective electrodes employing polymeric membranes. Author (GRA)

N77-22286# Army Materials and Mechanics Research Center, Watertown, Mass.
POLYPHENYLQUINOXALINE / POLY-PTOLYLQUINOXALINE COPOLYMERS: THE SEARCH FOR A CROSS-LINKABLE PPQ Final Report
Stanley E. Wentworth Sep. 1976 11 p
(DA Proj. 1T1-62105-AH-84)
(AD-A033254; AMMRC-TR-76-33) Avail: NTIS HC A02/MF A01 CSCL 07/3

As Part of a continuing effort to reduce or eliminate the thermoplasticity long associated with polyphenylquinoxalines, a series of phenylquinoxaline / p-tolylquinoxaline copolymers has been prepared and their thermal stability and cross-linkability evaluated. Previous studies have indicated poly-p-tolyquinoxaline PTQ to be significantly more cross-linkable but also markedly less thermo-oxidatively stable than polyphenylquinoxaline PPQ. Thus, an optimum copolymer composition combining the cross-linkability of PTQ and the stability of PPQ was sought. In fact, no such composition exists for this system. Whereas a small percentage of PTQ leads to substantial loss in stability, it has virtually no effect on cross-linkability. For example, the half-life at 400 C in air for 10% PPQ has been reduced by 55% relative to PPQ while its cross-linkability is almost unchanged. Apparently, the cross-linking reaction is inefficient such that only high concentrations of the cross-linkable species leads to a useful enhancement of the thermal cross-linkability. Conversely, the thermal oxidation reaction appears to be quite efficient. It is concluded that this copolymer approach can be successful in eliminating thermoplasticity if a system can be found in which the relative efficiency of the competing reactions is reversed. Author (GRA)

N77-22287# Naval Civil Engineering Lab., Port Hueneme, Calif.
FIELD TEST FOR DETECTING LEAD-BASED PAINTS Technical Note, Jul. - Dec. 1975
H. P. Vind and C. W. Mathews Sep. 1976 14 p refs
(yf54593012)
(AD-A033494; CEL-TN-1455) Avail: NTIS HC A02/MF A01 CSCL 07/2

A field method for determining whether the lead content of a paint film exceeds the 0.5% limit imposed by federal law and by NAVFAC Instructions appears to be partially fulfilled by a simple spot test introduced at the University of Rochester, New York. In the test, a drop of sodium sulfide solution is placed on a chip of paint, and layers of paint that contain lead turn black or gray. The Civil Engineering Laboratory (CEL) modified the lead-indicating reagent by adding solvents to improve its ability to penetrate paint and a thickening agent to simplify its application and improve its ability to adhere to walls and ceilings. In CEL tests with the modified sodium sulfide reagent, all the lead compounds tested gave positive results. Conveniently, the minimum concentration of lead that could be detected was approximately equal to the maximum legal limit of 0.5%. Nearly all of the other inorganic compounds commonly employed in the paint formulations reacted negatively. Exceptions were a few biocides and driers usually employed in paint in concentrations too low to interfere with the test for lead. Author (GRA)

N77-22288# Office of Naval Research, London (England).
THEORETICAL POLYMERS
T. A. Kitchens 7 Oct. 1976 9 p Summary of papers presented at UK Inst. of Phys. Conf. on Theoretical Methods in Polymer Phys., Leeds, England, 5-7 Jul. 1976
(AD-A033222; ONRL-C-29-76) Avail: NTIS HC A02/MF A01 CSCL 07/3

This report summarizes the papers presented at the two-day UK Institute of Physics conference on theoretical methods in polymer physics. The meeting was held at the University of Leeds 5-7 July 1976, and about twenty papers were presented on the excluded volume model, various treatments of the entanglement problem, the glassy and collapse transition, and the use of the renormalization group methods. Author (GRA)

N77-22289# Utah Univ., Salt Lake City. Dept. of Chemistry.
A THEORETICAL STUDY OF DEPOLARIZED RAYLEIGH SCATTERING TIME-CORRELATION FUNCTION OF A DILUTE POLYMER SOLUTION
Y-H. Lin and C. H. Wang 17 Nov. 1976 23 p refs
(Contract N00014-75-C-908; NR Proj. 051-562)
(AD-A033207; TR-13) Avail: NTIS HC A02/MF A01 CSCL 07/4

The depolarized Rayleigh spectra of macromolecules in solution have been studied theoretically. From a general expression of the time correlation function, two correlation functions respectively related to molecular rotation and local segmental motion are obtained in a natural way. Previous work has not demonstrated this connection. The result of the present analysis is valuable in the interpretation of the experimentally observed spectra of polymers in solution. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers, storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N77-22290*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HYDROGEN-ENRICHMENT-CONCEPT PRELIMINARY EVALUATION Final Report
E. Ecklund 15 Dec. 1975 221 p refs Sponsored by NASA, ERDA and EPA
(NASA-CR-152814; JPL-1200-237; TEC-75/007) Avail: NTIS HC A10/MF A01 CSCL 21D

A hydrogen-enriched fuels concept for automobiles is described and evaluated in terms of fuel consumption and engine exhaust emissions through multicylinder (V-8) automotive engine/hydrogen generator tests, single cylinder research engine (CFR) tests, and hydrogen-generator characterization tests. Analytical predictions are made of the fuel consumption and NO/sub x/ emissions which would result from anticipated engine improvements. The hydrogen-gas generator, which was tested to quantify its thermodynamic input-output relationships was used for integrated testing of the V-8 engine and generator. ERA

N77-22291# Battelle Pacific Northwest Labs., Richland, Wash.
POTENTIAL FOR PRODUCING AND MARKETING GASOLINE SUBSTITUTES FROM WESTERN COAL
J. W. Currie and D. J. Braun Sep. 1976 57 p refs
(Contract E(45-1)-1830)
(BNWL-2080(RAP-4)) Avail: NTIS HC A04/MF A01

A multisector model with regional detail was required to thoroughly assess the likelihood of commercial-scale liquefaction occurring in Montana and Wyoming under market conditions. Significant information was obtained from a constrained partial analysis. Some fundamental terminology used in this analysis is reviewed. Future demand and potential supply of gasoline from domestic crude oil are treated. The costs of supplying synthetic gasoline and methanol from western coal as well as the qualitative aspect of these fuels are examined. The supply and demand functions are solved simultaneously under various import schemes to trace out a family of gasoline-market equilibrium price curves over time. Three scenarios are then analyzed by comparing the costs of supplying synthetic fuels with the market equilibrium prices for gasoline. Market potential for the synthetic fuels is estimated for a wide range of coal prices. ERA

N77-22292# Federal Energy Administration, Washington, D. C. Office of Energy Information and Analysis.
PETROLEUM MARKET SHARES: A REPORT ON SALES OF DISTILLATE AND RESIDUAL FUEL OIL TO ULTIMATE CONSUMERS, 1975
Jun. 1976 57 p refs
(PB-260565/7; FEA/B-76/352) Avail: NTIS HC A04/MF A01 CSCL 21D

Nationally, refiner-marketers sold approximately 42 percent of their distillate fuel oil in 1975 to ultimate consumers (i.e., end-users and wholesale purchasers-consumers), and 58 percent of their volume to independent marketers as either branded or nonbranded product. Refiner-marketers sold nationally ap-

proximately 80 percent of their 1975 residual fuel to ultimate consumers and 20 percent of their volume to independent marketers as branded or nonbranded product. GRA

N77-22293# University Engineers, Inc., Norman, Okla.
SMALL SCALE TESTS ON CONTROL METHODS FOR SOME LIQUEFIED NATURAL GAS HAZARDS Final Report
L. E. Brown, W. E. Martinsen, S. P. Muhlenkamp, and G. L. Puckett May 1976 81 p refs
(Contract DOT-CG-42355-A)
(AD-A033522; UE-308-FR; USCG-D-95-76) Avail: NTIS HC A05/MF A01 CSCL 11/7

A report of results of small scale (100 square ft) tests of some liquefied natural gas (LNG) hazard control methods and concepts. Tests were run to estimate dry chemical flow rate requirements for the extinguishment of fires from LNG pools with obstructions in the pool area and fires from LNG pools on water in a containment. Objectives were to obtain data for design of large-scale tests. Other small-scale tests examined the feasibility of other concepts for controlling hazards from spills of liquefied natural gas. Agent application rates required for extinguishment of obstructed LNG fires and LNG fires on water are not different from those effective on unobstructed fires on dry surfaces (if the functionality between burning rate and application rate is accounted for). Care must be exercised to assure uniform powder distribution on obstructed fires. Tests of water spray screens to reduce downwind vapor concentrations showed that the concept is practical and effective for small LNG spills, and that the mechanism of reduction is the addition of turbulence in the vapor zone. Tests of water spray screens to reduce radiant heating of exposures demonstrated no practical value for the concept except as an uneconomical alternative where spray directly on the exposure is not possible. Author (GRA)

N77-22294# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT FOR BAYOU CHOCTAW SALT DOME
Dec. 1976 613 p refs
(PB-261984/9; FEA/S-76/501) Avail: NTIS HC A99/MF A01 CSCL 21D

The purpose of the SPR is to mitigate the economic impacts of any future interruptions of the petroleum imports. The Bayou Choctaw site, a salt dome with existing cavities located in Iberville Parish, Louisiana, was identified as a candidate site for the ESR because it offers the advantage of large storage capacity, easy access to the distribution network, and a relatively short preparation period. This site-specific EIS analyzes the environmental impacts caused by site preparation and operation. GRA

N77-22295# Pennsylvania State Univ., University Park. Dept. of Mineral Economics.
HISTORICAL TRENDS IN COAL UTILIZATION AND SUPPLY Final Report
Richard L. Gorden and George H. K. Schenck Aug. 1976 631 p refs
(Grant DI-BM-G0 155116)
(PB-261278/6; BM-OFR-121-76) Avail: NTIS HC A99/MF A01 CSCL 21D

Historical behavior of coal consumption, the forces that are affecting prospective coal use, and various scenarios of future consumption in selected markets were considered. GRA

N77-22296# American Defense Preparedness Association, Washington, D. C.
STATE-OF-THE-ART: MILITARY EXPLOSIVES AND PROPELLANTS PRODUCTION INDUSTRY. VOLUME 2: WASTEWATER CHARACTERIZATION Final Report
James Patterson, Norman I. Shapita, John Brown, William Duckert, and Jack Polson Aug. 1976 273 p
(Grant EPA-R-802872)
(PB-260918/8; EPA-600/2-76-213b) Avail: NTIS HC A12/MF A01 CSCL 19A

The military explosives and propellant manufacturing industry, covering both GOGO and GOGO facilities were surveyed. Sources of wastewater, volumes, and pollutant constituents were reported where such data existed. Treatment technology currently in use at the various installations was described, including effectiveness of pollutant removal and secondary (air and solid) waste generation. Systems under development at these military installations were also examined and evaluated in light of available information. GRA

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N77-22297# Oak Ridge National Lab., Tenn. Thermonuclear Div.
CRYOGENIC POWER TRANSMISSION TECHNOLOGY: CRYOGENIC DIELECTRICS Quarterly Report, 1 Jan. - 31 Mar. 1976
Jul. 1976 72 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5498; QR-13) Avail: NTIS HC A04/MF A01

Partial discharge inception and extinction were measured in various three-layer polymer film samples impregnated with pressurized cold helium gas. The behavior of the inception voltage is described with respect to variations in temperature, pressure, electrode geometry, and location of voids adjacent to the electrodes or midway through the dielectric. Preliminary dc breakdown tests on some of the same samples resulted in external flashover on the sample chamber rather than internal breakdown, but established a lower limit to the dc dielectric strength. The status of experimental equipment is reported, including improvements to low temperature thermometry instrumentation. The first of a series of bimonthly meetings was held to promote discussion of cryogenic dielectric problems between members of various superconducting power transmission line development projects. ERA

N77-22298# Sandia Labs., Livermore, Calif.
PROPOSAL FOR METRIC DIMENSIONING OF RAW STOCK MATERIALS
E. E. Alford Oct. 1976 34 p
(Contract E(29-1)-789)
(SAND-75-8065) Avail: NTIS HC A03/MF A01

A proposal was developed that minimizes the different sizes of raw stock that result when conversion is made from English to metric units. ERA

N77-22299# Mason and Hanger-Silas Mason Co., Inc., Amarillo, Tex.
COORDINATE MEASUREMENTS
Sep. 1976 6 p refs
(Contract DA11173-AMC-487A)
(MHSMP-76-39) Avail: NTIS HC A02/MF A01

Calibration of small inner surfaces was a continuing metrology problem due to prohibitive size of the gaging head, side force on the gaging stylus, difficulty in making radius sweeps, etc. The method has proven very useful, particularly for spherical radii in the bottom of a blind hole with a cylindrical wall. It is evident the method would be equally satisfactory for additional applications where conventional methods require complicated set-ups. This method was used on the Moore model 5-Z measuring machine. The heart of the system is a steel ball on a strain gage probe and a continuity circuit from the probe to the part. The part is insulated from the gage. An ohmmeter is connected to the part and the probe. Physical contact of the probe and part is instantly observed on contact. ERA

N77-22300# Los Alamos Scientific Lab., N. Mex.
CRYOSTATIC STABILITY EQUATION
S. G. Sydoriak 1976 5 p refs Presented at the 1976 Applied Superconductivity Conf., Stanford, Calif., 17-20 Aug. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2162; Conf-760829-29) Avail: NTIS HC A02/MF A01

Equations are presented which calculate the critical boiling heat flux for parallel wall vertical channels subject to either natural convection or forced flow boiling, with one or both walls heated. The one heated wall forced flow equation is discussed with

regard to design of a spiral wound solenoid (pancake magnet) having a slippery insulating tape between the windings. ERA

N77-22301# National Bureau of Standards, Washington, D. C.
WEIGHT AND MEASURES STANDARDS OF THE UNITED STATES: A BRIEF HISTORY
L. V. Judson Mar. 1976 44 p Supersedes COM-75-10211 (PB-261455/0; NBS-SP-447; LC-76-600055; COM-75-10211)
Avail: NTIS HC A03/MF A01 CSCL 14B

Weights and Measures Standards of the United States--a Brief History (1963), by Lewis V. Judson was updated where needed to bring it into accord with current usage. Important events involving weights and measures of the period 1963-1975, are discussed. GRA

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N77-22302*# Hughes Aircraft Co., Culver City, Calif. Space and Communications Group.
THE 10 MICROMETER TRANSMITTER Final Report
Dec. 1976 181 p refs
(Contract NAS5-20623)
(NASA-CR-152489; D0460; SCG-60517R) Avail: NTIS HC A09/MF A01 CSCL 17B

The design, fabrication tests, and engineering model components of a 10.6 mum wideband transceiver system are reported. The effort emphasized the transmitter subsystem, including the development of the laser, the modulator driver, and included productization of both the transmitter and local oscillator lasers. The transmitter subsystem is functionally compatible with the receiver engineering model terminal, and has undergone high data rate communication system testing against that terminal. Author

N77-22303 Frost and Sullivan, Inc., New York.
COMMUNICATION SATELLITE SYSTEMS MARKET IN DEVELOPING COUNTRIES FOR THE PERIOD 1976 - 1990, VOLUME 1
Sep. 1976 231 p
Copyright. Avail: Issuing Activity

Independent developing nations were assessed, each in respect of its policitol, economic, commercial, and industrial environment and development ambitions. Emphasis was placed on their telecommunications attainment in general and space communications involvement in particular. The results of the analysis of installed and projected bases for both satellite systems and their ground equipment is presented in the form of market and sales forecasts. Summary tabulations of these forecasts are also given. Author

N77-22304 Frost and Sullivan, Inc., New York.
COMMUNICATION SATELLITE SYSTEMS MARKET IN DEVELOPING COUNTRIES FOR THE PERIOD 1976 - 1990, VOLUME 2
Sep. 1976 235 p
Copyright. Avail: Issuing Activity
For abstract, see N77-22303.

N77-22305 British Broadcasting Corp., Kingswood (England). Engineering Div.
A 4-PHASE DIFFERENTIAL PHASE-SHIFT-KEYING STEREO SOUND SYSTEM: CARRIER RECOVERY METHODS
W. A. Mahadeva Jan. 1977 20 p refs
(BBC-RD-1977/1) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A system for carrying high quality stereophonic digital sound signals using 4 phase differential phase shift keying modulation was designed. Recovering the carrier at the receiver for synchronous demodulation was one of the problems encountered when developing the system. There are three methods of carrier recovery compared, namely phase-multiplication, remodulation, and baseband remodulation, and the measured performances of prototype equipment using the first and last of these three methods are described. Author

N77-22306 British Broadcasting Corp., Kingswood (England).
QUADRAPHONY: DEVELOPMENTS IN MATRIX H DECODING
P. S. Gaskell and P. A. Ratliff Feb. 1977 17 p refs
(BBC-RD-1977/2) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The basic form of decoder is a complex-coefficient linear matrix, but this has an inherent lack of separation between the output signals. Logic enhancement techniques are discussed, which seek to improve interchannel separations for the principal sound-source, at the expense of secondary sources. As an interim measure, a modified commercial logic-enhanced (Variomatrix) decoder was studied, which led to the development of a purpose-built logic-enhanced decoder for Matrix H. The latter combines the virtues of both linear Matrix H decoding, and the variable-matrix logic enhancement technique. All the decoders described are capable of providing a good surround-sound reproduction. In particular, a purpose-built Matrix H logic-enhanced decoder has been shown to exhibit a performance very close to a discrete 4-channel system; the failings normally associated with logic-enhanced decoders are almost inaudiable. Author

N77-22307 British Broadcasting Corp., Kingswood (England). Engineering Div.
TWO AUDIO TEST-SIGNAL GENERATORS FOR ASSESSING PROGRAMME-MODULATED NOISE IN DIGITAL COMPANDORS
W. I. Manson and D. F. Reid Feb. 1977 10 p refs
(BBC-RD-1977/4) Avail: BBC, Kingswood Warren, Tadworth, Surry, England

Two experimental generators are described which provide test signals intended principally for the investigation of program modulated noise in digital compandors. The forms of the test signals are such as to stimulate this effect with minimal masking of any impairment produced. One of the generators gives a sequence of notes in analogue form. The second generator provides a test signal in digital form. Transmitted by a perfect digital system, this test signal produces virtually no sound at the output. When processed by a digital system likely to produce program modulated noise, however, audible tones are generated which vary with the degree of imperfection of the system. Author

N77-22308 British Broadcasting Corp., Kingswood (England).
AIRBORNE TELEVISION TRANSMISSION
M. W. Harman and J. Middleton Feb. 1977 20 p refs
(BBC-RD-1977/5) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Approximate cost comparisons are made between different methods of transmission based on both capital and revenue expenditure. Author

N77-22309 British Broadcasting Corp., Kingswood (England). Engineering Div.
CEEFAX: MEASUREMENT TECHNIQUES
M. G. Croll Feb. 1977 16 p refs
(BBC-RD-1977/6) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Techniques were developed to measure the characteristics of a CEEFAX waveform and to assess the performance of a CEEFAX installation. Methods are discussed for measuring the normal CEEFAX waveform in terms of its level and other factors which affect the CEEFAX service at a receiving installation. Techniques are also described for assessing the CEEFAX performance of signal paths, using special test signals. Author

N77-22310*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A REAL TIME, LOW COST, DATA ACQUISITION TELECOMMUNICATION NETWORK
R. R. Schulte [1976] 22 p
(NASA-TM-X-73645; E-9151) Avail: NTIS HC A02/MF A01 CSCL 17B

The real time, low cost data acquisition communication network described features the use of asynchronous ASCII code transmissions operating at 30 characters per second on the dial-up telephone system. The network features an elaborate, but easily generated error checking system, operating in a line-by-line demand-response mode. The system is readily adaptable for any low speed computer-to-computer data transmissions requiring high reliability in data transmission. The network was developed for the acquisition of prelaunch wind data from the Eastern Test Range at Cape Kennedy. Author

N77-22311*# West Virginia Univ., Morgantown. Dept. of Electrical Engineering.
THREE-DIMENSIONAL VECTOR MODELING AND RESTORATION OF FLAT FINITE WAVE TANK RADIOMETRIC MEASUREMENTS Final Report
William M. Truman and Constantine A. Balanis 15 May 1977 233 p refs
(Grant NGR-49-001-056)
(NASA-CR-152687) Avail: NTIS HC A11/MF A01 CSCL 20N

The three-dimensional vector interaction between a microwave radiometer and a wave tank was modeled. Computer programs for predicting the response of the radiometer to the brightness temperature characteristics of the surroundings were developed along with a computer program that can invert (restore) the radiometer measurements. It is shown that the computer programs can be used to simulate the viewing of large bodies of water, and is applicable to radiometer measurements received from satellites monitoring the ocean. The water temperature, salinity, and wind speed can be determined. Author

N77-22312*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PUBLIC SERVICE COMMUNICATIONS SATELLITE USER REQUIREMENT WORKSHOP Final Report
Edward A. Wolff, ed. Jan. 1977 460 p refs Workshop held at Easton, Md., 17-19 Oct. 1976
(NASA-TM-X-72608) Avail: NTIS HC A02/MF A01 CSCL 17B

A workshop was held to obtain information on user requirements for public service communications. This information will provide the basis of a study to determine the optimum satellite system to satisfy user requirements. The concept for such a system is described. The workshop examined requirements for data and message services, elementary and secondary education, extension and continuing education, environmental communications, library services, medical education, medical services, public broadcasting, public safety, religious applications, state and local communications, and voluntary services. Information was also obtained on procedures to follow to make the transfer to commercial services. Author

N77-22313*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PATTERNS OF BROAD-BEAM ANTENNAS OF DIFFERENT POLARIZATIONS NEXT TO SIMPLE HANGAR MODELS
C. R. Cockrell Apr. 1977 41 p refs
(NASA-TM-X-71940) Avail: NTIS HC A03/MF A01 CSCL 20N

Broad-beam antennas of different polarizations radiating next to simple hangar models are investigated. Expressions that represent the elevation-plane patterns of slots in and 1/4 wavelength monopoles on a finite rectangular ground plane upon which a rectangular scattering object was placed were derived using geometrical theory of diffraction. These expressions were obtained by superposing the infinite ground plane solutions, reflected field solutions from the scattering object and diffracted field solutions in their respective regions of validity. Patterns for a 1/2 wavelength slot and 1/4 wavelength electric monopole are verified experimentally for a number of source locations. Data pertaining to the polarization question in regard to the multipath problem are presented. Author

N77-22314*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
A SYSTEM FOR SYNCHRONIZING SYNTHESIZERS OF COMMUNICATION SYSTEMS Patent Application
E. Enriquez (Hughes Aircraft Co., Los Angeles) and R. Gookin, inventors (to NASA) (Hughes Aircraft Co., Los Angeles) Filed 11 Apr. 1977 49 p Sponsored by NASA
(NASA-Case-GSC-12148-1; US-Patent-Appl-SN-786322) Avail: NTIS HC A03/MF A01 CSCL 17B

Frequency synthesizers at two stations that communicate with each other via a transmission link having a constant propagation delay time are started and synchronized by transmitting a tone from the first station to the second station. At the second station, the tone initiates a tone burst having a predetermined frequency and duration. At a predetermined time interval, after the derivation of the trailing edge of the tone burst, the synthesizer at the station is activated. The tone burst and frequencies derived from the synthesizer at the second station are transmitted in sequence from the second station to the first station. Detection of the trailing edge of this tone burst then initiates operation of the synthesizer at the first station. The frequencies derived from the synthesizer at the second station are received at the first station and are combined with the frequencies derived from the synthesizer at the first station to derive a constant beat frequency as the two synthesizers are stepped. NASA

N77-22315# Office of Telecommunications, Boulder, Colo.
A SIMULATION MODEL FOR ANALYZING PERFORMANCE OF SOME SIMPLE COMMUNICATION SYSTEMS ON A DIGITAL COMPUTER
Hiroshi Akima and Arthur D. Spaulding Nov. 1976 83 p refs
(Contract DOT-FA74WAI-431)
(AD-A036437; FAA-RD-76-181) Avail: NTIS HC A05/MF A01 CSCL 17/2

A digital computer simulation model for analyzing performances of some simple communication systems is being developed for the purpose of studying the effects of interfering signals, noise, and/or distortions on various communication systems. Development of the model is largely based on the analogy with the laboratory tests of communication system performances. The model consists of computer subprograms, each of which either simulates a basic component of communication systems or calculates characteristics of a component. An introductory explanation of computer simulation, guidelines for developing a simulation model, an outline of the model, and some example programs are presented. Complete Fortran listings and a user manual are also presented. Author

N77-22316# Sandia Labs., Albuquerque, N.Mex.
TRANSMISSION OF HIGH FREQUENCY DATA FROM ROCKET SLEDS THROUGH SCREEN BOXES
D. L. Preston Aug. 1976 14 p
(Contract E(29-1)-789)
(SAND-76-0067) Avail: NTIS HC A02/MF A01

The screen box technique was modified to investigate its use in transmitting high frequency data from the rocket sled to a ground base recording station near the track. Three highly successful high frequency data tests at speeds near Mach 5 show that high frequency data generated during a rocket sled impact of any velocity achievable at Sandia can be transmitted to recording stations through a conventional rocket sled screen box system. The presence of a rocket sled traveling at hypersonic velocities through a screen box does not degrade, distort, or otherwise alter data being transmitted through the screen box. Additionally, no dropouts or loss of signal of any type was in evidence while using screen boxes as data links. ERA

N77-22317# California Univ., Livermore. Lawrence Livermore Lab.
COMPUTER ANALYSIS OF THE BOTTOM-FED FAN ANTENNA
G. J. Burke and A. J. Poggio 19 Aug. 1976 17 p refs
(Contract W-7405-eng-48)
(UCRL-52109) Avail: NTIS HC A02/MF A01

The bottom-fed fan antenna, which is used by the U.S. Navy for communication in the high frequency band, was analyzed by computer techniques. Some models for the antenna were evaluated, and the effects of the antenna support structure were studied. The study determined that an accurate thin-wire model for the antenna and support structure can be constructed and

that the mast has a significant effect on the antenna input impedance. ERA

N77-22318# Los Alamos Scientific Lab., N. Mex.
ELECTROMAGNETIC RADIATION FROM A ROCKET MOTOR
C. U. Benton, H. M. Fowles (Denver Univ.), and P. K. Goen (Sandia Labs., Albuquerque, N. Mex.) May 1976 6 p refs
(Contract W-7405-eng-36)
(LA-6357-MS) Avail: NTIS HC A02/MF A01

EMP payload on the Waso rocket experiment permitted a quantitative measurement of electromagnetic radiation generated by the Terrier and Sandhawk solid propellant rocket motors. Field strength of 6-MHz-bandwidth signals through six filtered channels with center frequencies of 20, 30, 40, 50, 60, and 70 MHz was recorded. These data together with some qualitative observations are presented. ERA

N77-22319# Los Alamos Scientific Lab., N. Mex.
SOME COMPARISONS OF WALSH TRANSFORMATIONS AND FOURIER TRANSFORMATIONS FOR SPEECH COMPRESSION
William L. Briscoe and James P. Shipley Sep. 1976 17 p refs
(Contract W-7405-eng-36)
(LA-6512-MS) Avail: NTIS HC A02/MF A01

It is believed that there will soon be a demand for systems to enable telephone and other voice-grade channels to transmit simultaneously voice communication and one additional service such as facsimile, slow-scan television, or a data channel. The advent of charge coupled devices holds the possibility of reducing the cost of the hardware for providing this channel-sharing to a practical level. A computer model of the speech portion of such a system is discussed. The merits of using the Walsh Transform vs the Fourier Transform as a means of reducing the bandwidth required for the voice component are evaluated along with hardware costs. ERA

N77-22320# Army Electronics Command, Fort Monmouth, N.J.
EXPECTED DIGITAL TRANSMISSION PERFORMANCE DURING MOTION IN A JUNGLE ENVIRONMENT Final Report
George Cohen Oct. 1976 22 p refs
(DA Proj. 1S7-62701-AH-92)
(AD-A032159; ECOM-4443) Avail: NTIS HC A02/MF A01 CSCL 20/14

Fading measurements were made from information available on the behavior of a VHF carrier propagating through a jungle environment. A determination was made of the fading rates that could be expected when relative motion exists between the receiver and transmitter. Based upon these fading rates, predictions are made of the bit error rates that could be expected from a VRC-12 communication system operating in the test environment. Author (GRA)

N77-22321# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
A DEMONSTRATION AND EVALUATION OF THE UTILIZATION OF SIDE LOOKING AIRBORNE RADAR FOR MILITARY TERRAIN ANALYSIS Final Report
Louis F. Dellwig, Bradford C. Hanson, Norman E. Hardy, Julian C. Holtzman, and Paul L. Hulen 1 Oct. 1976 156 p refs
(Contract DAAG02-75-C-0145)
(AD-A033557; RSL-TR-288-1; ETL-0023) Avail: NTIS HC A08/MF A01 CSCL 17/9

Side looking airborne radar (SLAR) imagery acquired in diverse terrains and environments was studied to demonstrate its value in military tactical terrain analysis. Capabilities unique to SLAR, such as all-weather and day or night image acquisition, are highlighted. In addition, other capabilities and limitations are also stressed to permit the utilization of SLAR with other sensors for maximum data retrieval. Imagery studied was selected on the basis of geographic location and data content, not system characteristics, and estimates are made of the improved data content that could be realized by modification of system parameters. By using a broader range of the electro-magnetic spectrum than most sensors and by operating under many controllable parameters, the appropriate radar system and system configuration can be selected for any mission by the user to realize maximum target information. Author (GRA)

N77-22322# Naval Research Lab., Washington, D. C.
FORMULATION OF A PLATFORM-TO-PLATFORM RADAR INTEGRATION SYSTEM
B. H. Cantrell, A. Grindlay, and C. H. Dodge Dec. 1976 60 p refs
(NRL Proj. R12-18)
(AD-A033274; NRL-MR-3404) Avail: NTIS HC A05/MF A01 CSCL 17/9

A formulation of the radar integration segment of a Tactical Data System is presented in this report. The main features consist of the filtered set of raw detections containing the most tract information, a data compression procedure for transmission over a communication link, and the concept of a distributed system operating philosophy. Other features included are a simple error analysis technique using a truncated Taylor series, a new formulation of the grid-lock problem, a simple track filter, and a discussion of coordinate systems and their relationships. GRA

N77-22323# Adaptronics, Inc., McLean, Va.
ADAPTIVE NONLINEAR SIGNAL PROCESSING FOR CHARACTERIZATION OF ULTRASONIC NDE WAVEFORMS. TASK 2: MEASUREMENT OF SUBSURFACE FATIGUE CRACK SIZE Final Technical Report, 1 May 1974 - 1 Sep. 1975
Ramesh Shankar, Anthony N. Mucciardi, Dixon Cleveland, William E. Lawrie (Babcock and Wilcox Co., Lynchburg, Va.), and Henry L. Reeves (Babcock and Wilcox Co., Lynchburg, Va.) Jun. 1976 165 p refs
(Contract F33615-74-C-5122; AF Proj. 7351)
(AD-A031464; AFML-TR-76-44) Avail: NTIS HC A08/MF A01 CSCL 20/1

A new NDE nonlinear signal processing system has been developed to detect and measure small, subsurface fastener hole fatigue cracks. The system synthesized from nondestructive evaluation (NDE) waveform parameter inputs is capable of detecting and measuring quantitatively subsurface fatigue cracks in the size range of 0 to 279 mils to within 70 percent of their nominally characterized lengths. Previous investigations had achieved a 50 percent detection rate for cracks larger than 30 mils, and no detection capability for cracks smaller than 30 mils. However, the fatigue crack measurement system reported herein is the first known fatigue crack NDE system capable of detection and measurement for this wide range. The NDE waveforms were recorded from sixteen aluminum sample specimen cracks under two different experimental conditions. Series 1 was recorded with the ultrasonic transducer wedge at 20 deg to the plane of the material surface, and Series 2 with the wedge at 30 deg. A 10 MHz transducer was used for both series. GRA

N77-22324# Geological Survey, Denver, Colo.
ELECTROMAGNETIC SCATTERING BY MULTIPLE CONDUCTORS IN THE EARTH DUE TO A PLANE WAVE SOURCE Final Report
Walter L. Anderson, Gerald W. Hohmann (Kennecott Exploration, Inc.), and Bruce D. Smith 1976 78 p refs
(PB-261183/8; USGS-GD-76-019) Avail: NTIS HC A05/MF A01 CSCL 20N

A DECsystem-10 FORTRAN 4 program (called SCATPW) is described for computing the electromagnetic scattering by multiple conductors in the earth due to a plane wave source. The plane wave mode is for the electric field parallel to the strike of multiple two-dimensional rectangular bodies buried in a conductive halfspace, where each body has the same constant conductivity contrast with respect to the halfspace. An option is provided to simulate dipping bodies. The program computes at the surface: apparent resistivity, impedance, ellipticity, tilt-angle, and the electric and magnetic field components over the bodies. The numerical technique involves an approximation to an integral equation which only requires a solution within the cross-sectional bodies and not thoughout the half-space. The report defines program input parameters in detail for proper program execution. The complete (psuedo ANSI) FORTRAN 4 source code is listed,

along with four example input/output problems and external plots of the results. GRA

N77-22325# National Academy of Sciences - National Research Council, Washington, D. C. Committee on Telecommunications.
ELECTRONIC MESSAGE SYSTEMS FOR THE US POSTAL SERVICE Final Report, 30 Jun. 1975 - 31 Dec. 1976
Dec. 1976 60 p refs Sponsored by the US Postal Service
(PB-262892/3; NRC/TELECOM-76/5) Avail: NTIS HC A04/MF A01 CSCL 17B

The U.S. Postal Service (USPS) Support Panel suggested that Postal Service involvement in EMS be carried out on an evolutionary basis, with a strong management commitment to allocating adequate resources for this major innovation on a sustained basis. The Postal Service could lease or own segments of the electronic message system, but the overall system needs to be managed by the USPS for maximum effectiveness. GRA

N77-22326# Office of Telecommunications, Annapolis, Md.
AN AUTOMATED PROCEDURE FOR PREDICTING POTENTIAL ELECTROMAGNETIC INTERFERENCE BETWEEN SPACE AND TERRESTRIAL SYSTEMS WITHIN THE COORDINATION AREAS IN THE BANDS BETWEEN 7.25 AND 8.4 GHz
William M. Moran, Carl Winkler, and William Gamble Aug. 1976 135 p refs
(PB-261229/9; OTR-76-100) Avail: NTIS HC A07/MF A01 CSCL 17B

A computer program was developed which is designed to identify potential electromagnetic interference problems between a satellite system earth station and the operational terrestrial environment within the earth station coordination contour. The terrestrial environment is obtained by selecting from the GMF records of those systems which share the same frequency band (7.25-8.4 GHz) as the earth station and are located within the coordination area. The output of the computer program is a subfile of those situations which appear to be a potential EMC problem. GRA

N77-22327# Lincoln Lab., Mass. Inst. of Tech., Lexington.
PHASED ARRAY ANTENNAS Final Report, Apr. 1973 - Jun. 1975
A. Hessel, S. Barone, and B. R. Cheo Mar. 1976 320 p refs Prepared by Polytech. Inst. of N. Y., Farmingdale
(Contract F19628-73-C-0002; DA Proj. 8X3-63304-D-215)
(AD-A031472; ESD-TR-76-78) Avail: NTIS HC A14/MF A01 CSCL 09/5

The report contains theoretical analysis and computed results for various types of phased arrays. Arrays on the exterior of a conducting sphere and on the interior of a conducting cylinder are treated in the first two chapters. The spiral antenna is dealt with, as an isolated element and in an infinite array, in the next two chapters. The last chapter contains the analysis of ridge waveguide arrays and a study of their wide band performance. GRA

N77-22328# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A SUMMARY OF METHODS FOR PRODUCING NULLS IN AN ANTENNA RADIATION PATTERN
Leon J. Ricardi 2 Sep. 1976 45 p refs
(Contract F19628-76-C-0002)
(AD-A032340; TN-1976-38; ESD-TR-76-254) Avail: NTIS HC A03/MF A01 CSCL 09/5

The report presents a brief introductory description of adaptive nulling antenna systems and their essential components, with particular emphasis on satellite communications applications. The principal difference between the inherent performance of array and multiple-beam antennas is discussed. Bandwidth, nulling performance versus degrees of freedom, commonly used circuits, etc. are also discussed. It is pointed out that the algorithm for determining the method for combining the received signals at each of the antenna's N terminals is a most important and central issue in any system. Several algorithms are discussed, and their relationship to the general least mean square (power inversion) algorithm is pointed out. Finally a new method for evaluating the performance of nulling antennas is described. GRA

N77-22329# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
PROTOCOL PROBLEMS ASSOCIATED WITH SIMPLE COMMUNICATION NETWORKS M.S. Thesis
Roger J. Camrass Jul. 1976 103 p refs
(Contract N00014-75-C-1183; Grant NSF ENG-75-14103; ARPA Order 3045)
(AD-A032030; ESL-R-673) Avail: NTIS HC A06/MF A01 CSCL 09/4

Control or protocol information must generally accompany messages in a communications network in order to keep track of the beginning, end and destination of each message. Such additional data constitutes a network overhead, and occupies valuable network resources. For economic reasons it is important to keep this overhead to a necessary minimum. An efficient method for encoding protocol information, based on source coding, is applied to the coding of the beginning, end and destination of a message, and the results are compared to existing schemes. GRA

N77-22330# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
DESIGN OF A RETRANSMISSION STRATEGY FOR ERROR CONTROL IN DATA COMMUNICATION NETWORKS M.S. Thesis
Seyyed J. Golestaani Jul. 1976 113 p refs
(Contract N00014-75-C-1183; Grant NSF ENG-75-14103; ARPA Order 3045)
(AD-A032031; ESL-R-674) Avail: NTIS HC A06/MF A01 CSCL 09/4

Several retransmission strategies with different degrees of flexibility for various applications in data communication between two terminals are analyzed and compared with each other. A method for proving the correctness of a strategy is developed and used in each case. A new strategy for continuous transmission systems with variable block length (which is a rather general situation) is designed, using about one bit of error control data per block. It is an ordered retransmission scheme which assumes a constant round trip delay for the channel and takes advantage of this to specify block(s) in demand for retransmission. It has an advantage over other schemes designed earlier in the sense that it does not interpret an erased incoming block as a block containing a repeat request; hence it is more efficient. The strategy is then showed to be applicable to more specific cases such as constant block length and/or stop and wait transmission. GRA

N77-22331# Ohio State Univ., Columbus. Electroscience Lab.
PLANE WAVE EXPANSION FOR ARRAYS OF DIPOLES OR SLOTS IN PRESENCE OF DIELECTRIC SLABS
B. A. Munk, R. D. Fulton, and R. J. Luebbers Wright-Patterson AFB, Ohio AFAL Sep. 1976 83 p refs
(Contract F33615-73-C-1173; AF Proj. 7633)
(AD-A031757; ESL-3622-6; AFAL-TR-76-53) Avail: NTIS HC A05/MF A01 CSCL 09/5

The report presents the admittance properties of slot arrays in the presence of dielectric layers. The work relates to the design of metallic radomes. The report discusses the admittance properties of slot arrays in the presence of dielectric layers as a stepping stone to the transmission properties. These admittance properties are also applicable to phased arrays. In particular, the admittance is shown here to be almost independent of scan angle up to plus or minus 70 deg in the E-, H- and 45 deg plane. This was obtained by proper use of dielectric layers mounted adjacent to the slotted surface. The presence of surface waves is also investigated, and ways to avoid them are pointed out. Finally, the effect of a semi-infinite dielectric media upon an array of dipoles is determined. GRA

N77-22332# Ohio State Univ., Columbus. Electroscience Lab.
TRANSMISSION THROUGH A BI-PLANAR SLOT ARRAY SANDWICHED BETWEEN THREE DIELECTRIC LAYERS Technical Report, Mar. 1973 - Nov. 1975
B. A. Munk and R. D. Fulton Wright-Patterson AFB, Ohio AFAL Sep. 1976 111 p refs
(Contract F33615-73-C-1173)
(AD-A032160; ESL-3622-7; AFAL-TR-76-18) Avail: NTIS

HC A06/MF A01 CSCL 09/5

This report considers transmission through two metallic surfaces provided with small resonant slots where the two screens are separated by a dielectric slab of relative dielectric constant 2. They are coated on the outside with dielectric slabs of dielectric constant 1 and 3. It is shown that such a configuration can be disigned to yield a transmission curve with band-pass characteristics, i.e., yielding essentially unity transmission coefficient over a certain frequency range (narrow band) for angles of incidence up to as high as 80 deg from broadside in both the E- as well as the H-plane. The value to the Air Force of such surfaces lies in their potential use in metallic radomes. In this connection, it should be pointed out that metallic radomes possess several inherent advantages such as: (a) lightning protection, (b) reduction of precipitation noise, and (c) potentially higher mechanical strength. It is demonstrated that the dielectric on the outside by proper design makes the bandwidth almost constant with angle of incidence in both the principal planes, while the dielectric between the two slot arrays provides the proper coupling between the two arrays. Author (GRA)

N77-22333# TRW Systems Group, Redondo Beach, Calif.
CHARGE COUPLED DEVICES IN SIGNAL PROCESSING SYSTEMS. VOLUME 3: DIGITAL FUNCTION FEASIBILITY DEMONSTRATION Technical Report, Jan. 1975 - Feb. 1976
Thomas A. Zimmerman, Roland J. Handy, Reginald A. Allen, Earl E. Swartzlander, Jr., and Douglas J. Heath Mar. 1976 143 p refs
(Contract N00014-74-C-0068)
(AD-A031520) Avail: NTIS HC A07/MF A01 CSCL 09/5

In 1973 the Navy began a program to investigate and demonstrate the impact of the use of charge coupled devices (CCDs) in the digital domain. The concept of digital signal processing with CCDs is discussed briefly. Two implementations of an adder circuit are described and the development of each implementation in arrays to perform arithmetic operations is shown. The experimental results derived from these individual adders and the overall arrays is presented along with some theoretical models. Also presented are the results of a study to determine an efficient means of interconnecting a number of independent processors; the digital CCD development program is expected to produce such independent data processors contained on one or two chips. The study describes a method of interfacing an arbitrary number of such processors that employs distributed network control and exhibits soft failure. GRA

N77-22334# Air Force Geophysics Lab., Hanscom AFB, Mass.
OPERATIONAL CAPABILITY OF A WEATHER RADAR TIME LAPSE COLOR DISPLAY SYSTEM
Pio J. Petrocchi 3 Nov. 1976 6 p refs Reprint Presented at 17th Conf. on Radar Meteorol., Seattle, 26-29 Oct. 1976
(AD-A032005; AFGL-TR-76-0257) Avail: NTIS HC A02/MF A01 CSCL 17/9

A weather radar processor and color display capable of storing up to 40 complete radar PPIs and displaying these in color and in time lapse fashion has been tested at the AFGL Weather Radar Facility. Operation in various seasonal weather situations has enabled the examination of a number of system variables, such as the rate of picture acquisition, rate of picture display, color thresholding, range and azimuthal resolution and optimum combinations thereof. The real time self-briefing feature of the system is discussed and illustrated with still and motion pictures of a number of case studies. A brief description of the system hardware and software and a discussion of future expansion is presented. Author (GRA)

N77-22335# National Environmental Satellite Service, Washington, D. C. Office of Systems Engineering.
GUIDE FOR DESIGNING RF GROUND RECEIVING STATIONS FOR TIROS-N
John R. Schneider Dec. 1976 135 p refs Sponsored by NOAA
(PB-262931/9; NOAA-TR-NESS-75; NOAA-S/T-76-2444; NOAA-76121313) Avail: NTIS HC A07/MF A01 CSCL 04A

Known spacecraft and orbital information, minimum parameters required to define signal thresholds and signal level ranges, a few words on antenna tracking, and examples of the design process are presented. The goals and objectives of the third generation polar satellite and design parameters of the planned orbit and spacecraft are described. Information is supplied to determine the data threshold and RF signal range expected. The antenna gains, system noise temperatures, and dynamic range of the RF receiving system are derived for all TIROS-N data downlinks. GRA

N77-22336# Naval Undersea Center, San Diego, Calif.
PROCESSOR STRUCTURE FOR THE DETECTION OF A SINUSOID SIGNAL OBSCURED BY WHITE NOISE Research and Development Report, Sep. - Dec. 1975
W. S. Hodgkiss Aug. 1976 26 p refs
(AD-A033333; NUC-TP-528) Avail: NTIS HC A03/MF A01 CSCL 09/4

Currently employed methods for the detection of a sinusoid obscured by white noise are related to three classical problems of detection theory. The discrete Fourier transform, the power spectrum, and the averaged power spectrum each are shown to be the optimal processor (in the sense of making a least-risk decision) for a particular signal model. GRA

N77-22337# Harry Diamond Labs., Adelphi, Md.
BANDWIDTH SUBSTITUTION TECHNIQUE FOR ABSOLUTE MEASUREMENT OF POWER AT ALL RADIO FREQUENCIES
Abraham Singer and Jan M. Minkowski Oct. 1976 14 p refs
(AD-A033120; HDL-TR-1786) Avail: NTIS HC A02/MF A01 CSCL 09/3

A highly sensitive technique for making absolute measurements of power at all radio frequencies is described. This technique surmounts the primary shortcomings of the other existing techniques in that it permits absolute measurement of power at all radio frequencies, whereas all other techniques except one, the Incremental Method, are inherently frequency limited, with the current upper limit being about 75 GHz. This major advantage stems from the fact that this technique uses a direct comparison of the unknown RF power with a primary standard, whereas the other techniques (except for the Incremental Method) require a conversion of the power to heat before the comparison can be made. The main advantage of this technique over the Incremental Method is that it has much higher sensitivity, permitting absolute measurement of RF power to be made down to about -100 dBm, compared with only about -10 dBm for the Incremental Method. An additional advantage of this technique is that it permits the measurement of noise as well as coherent RF power, whereas the Incremental Method is valid only for coherent RF. Author (GRA)

N77-22338# General Electric Co., Schenectady, N.Y. Automation and Control Lab.
DYNAMIC BANDWIDTH Technical Report, Jan. - Jun. 1975
T. G. Kincaid Oct. 1976 22 p refs
(Contract N00014-71-C-0229)
(AD-A033413; SRD-76-109) Avail: NTIS HC A02/MF A01 CSCL 09/4

Rihaczek has defined the dynamic bandwidth of a signal as the square root of the magnitude of the derivative of the instantaneous frequency. This tutorial report reviews the work of Rihaczek and Baghdady on the practical applications of this quantity. It is shown that the dynamic bandwidth is useful as a measure of (1) the frequency spread of the signal energy about the instantaneous frequency, (2) the time stability of the instantaneous frequency, and (3) the minimum bandwidth of a filter that can pass the signal without significant phase distortion. Author (GRA)

N77-22339# Mississippi Univ., University. Dept. of Electrical Engineering.
DYNAMIC ANALYSIS OF A LOADED CONICAL ANTENNA OVER A GROUND PLANE Final Report
Donald R. Wilton Aug. 1976 89 p refs
(Grant AF-AFOSR-2832-75; AF Proj. 9751)
(AD-A033286; AFOSR-76-1080TR) Avail: NTIS HC A05/MF A01 CSCL 09/5

Integral equations are derived and solved numerically for

the current distribution on a resistively loaded conical antenna over a ground plane. Representative current distributions, input impedance values, and radiation patterns are given for the loaded and unloaded structure with and without a topcap.
Author (GRA)

N77-22340# Naval Electronics Lab. Center, San Diego, Calif. Propagation Technology Div.
SIMPLIFIED VLF/LF MODE CONVERSION PROGRAM WITH ALLOWANCE FOR ELEVATED, ARBITRARILY ORIENTED ELECTRIC DIPOLE ANTENNAS Interim Research Report, Mar. - Sep. 1976
R. A. Pappert and L. R. Shockey 10 Oct. 1976 85 p refs (NELC Proj. M402)
(AD-A033412; NELC-IR-771) Avail: NTIS HC A05/MF A01 CSCL 09/5

This report presents an updated version of an earlier simplified mode conversion program for VLF/LF propagation in the earth-ionosphere waveguide. The new program includes the provision for calculating at an arbitrary height. Within the guide, all three electric field components were generated by an electric dipole of arbitrary orientation and height. The program is designed for treating air to air, ground to air, or air to ground VLF/LF problems involving a waveguide channel which is horizontally inhomogeneous along the direction of propagation. Author (GRA)

N77-22341# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
EFFECT OF IMPERFECT GROUND PLANE ON NONLINEAR INHOMOGENEOUS ANTENNA
Tapan K. Sarkar, Donald D. Weiner, and Roger F. Harrington Nov. 1976 29 p refs
(Contract N00014-76-C-0225)
(AD-A032701; TR-76-11; TR-4) Avail: NTIS HC A03/MF A01 CSCL 09/5

The multiple port Volterra series analysis of nonlinear systems is applied to nonlinear inhomogeneous antennas. The presence of an imperfect ground plane near the antenna structure has an influence on the scattered fields radiated at different harmonic frequencies. Author (GRA)

N77-22342# Mitre Corp., Bedford, Mass.
MODIFICATION OF THE AN/TRC-97 TROPOSCATTER RADIO TERMINAL TO PROVIDE TRI-TAC COMPATIBILITY
E. P. Runnells, A. R. Sherwood, and W. P. Wang Oct. 1976 64 p refs
(Contract F19628-77-C-0001; AF Proj. 6900)
(AD-A032957; MTR-3284; ESD-TR-76-277) Avail: NTIS HC A04/MF A01 CSCL 17/2

In response to HQ USAF direction, a study was conducted to determine an appropriate modification to the AN/TRC-97 to provide a digital trunking capability and to complement the new TRI-TAC AN/TRC-170 tropo terminals. This report is a summary of the study results which were presented to HQ USAF on 18 June 1976. The modification is described and the proposed 'digital AN/TRC-97' is compared to a AN/TRC-170 on technical and life cycle cost bases. A recommended implementation plan and program schedule also are presented. Author (GRA)

N77-22343# Mitre Corp., Bedford, Mass.
CVSD PROCESSING OF QUASI-ANALOG SIGNALS, IMPLICATIONS FOR TRI-TAC APPLICATIONS. VOLUME 1: SUMMARY
T. E. Allen, E. J. Boyle, Jr., R. A. Costa, and C. R. Husbands Oct. 1976 52 p refs
(Contract F19628-77-C-0001; AF Proj. 6900)
(AD-A032958; MTR-3250-Vol-1; ESD-TR-76-276-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 17/2

In support of the USAF Program Office element of TRI-TAC, a series of laboratory and field environment tests were conducted by The MITRE Corporation to assess Continuously Variable Slope Delta (CVSD) modulation techniques for processing of quasi-analog signals. The results of these tests are presented in four volumes. This volume, Volume 1, is an executive summary of all the test results. Author (GRA)

N77-22344# Naval Research Lab., Washington, D. C. Space Systems Div.
ON THE POSSIBILITY THAT SPORADIC E IONIZATION IS A SOURCE FOR CERTAIN SCINTILLATION DISTURBANCES IN THE UHF CHANNELS OF FLEETSATCOM
John M. Goodman Oct. 1976 16 p refs
(AD-A032995; NRL-MR-3396) Avail: NTIS HC A02/MF A01 CSCL 17/2

The concept of wedge refraction is discussed and calculations of the amounts of refractive bending for possible models of sporadic E patches are presented. A general concept is developed but emphasis is placed upon possible effects at 250 MHz. For certain conditions, sporadic E patches may produce measurable fading effects observable at a ground terminal receiving UHF transmissions from a synchronous satellite. It is tentatively concluded that these phenomena will be most evident at mid-latitudes during summer daytime conditions. Single patches will produce quasi-periodic disturbances at each edge lasting the order of a minute, while, multiple patches will increase the disturbance duration. Noise-like disturbances will be produced for nonuniform wedges or wedge super-position. Predictions of E sub s scintillation effects of FLEETSATCOM are no better than the prediction of E sub s patches which is obviously poor from a deterministic point of view. Only statistical information based upon archival data is available. Use of the vertical incidence ionosonde at Wallops Island, Virginia is suggested for extracting real-time assessment of the E sub s scintillation possibility at NAVCOMSTA, Norfolk. Author (GRA)

N77-22345# Electronics Engineering Group (1842nd), Richards-Gebaur AFB, Mo.
A LOCAL AREA TEST CENTER
Keith C. Morton, Dahl B. Metters, and Virgilio P. Arafiles 15 Jul. 1976 24 p refs
(AD-A032581; Rept-1842-EGG/EPECW-TR-77-3) Avail: NTIS HC A02/MF A01 CSCL 17/2

The increasing demand for the transmission of widely disparate and complex communications signals over the base communication system will continue to place enormous loads upon the base cable plant as well as the operations and maintenance personnel involved. This report describes the various alternatives that may be applied to solve this growing problem.
Author (GRA)

N77-22346# Advisory Group for Aerospace Research and Development, Paris (France).
NEW DEVICES, TECHNIQUES AND SYSTEMS IN RADAR
Feb. 1977 591 p In ENGLISH; partly in FRENCH Presented at the Avionics Panel Symp., The Hague, Netherlands, 14-15 Jun. 1976
(AGARD-CP-197) Avail: NTIS HC A25/MF A01

Progress in the development of radar systems, such as devices that offer greater reliability, lower cost, and reduced space/weight demands, are considered. The topics covered include: devices and modules, radar techniques, target, clutter and propagation, and simulation and detection theory. For individual titles, see N77-22347 through N77-22385.

N77-22347# Royal Radar Establishment, Malvern (England).
SOLID STATE MICROWAVE AMPLIFIERS AND LOCKED OSCILLATORS FOR COHERENT RADAR TRANSMITTERS
I. W. Mackintosh, P. W. Braddock, M. Dixon, R. Genner, and R. J. Royds *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 13 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The emphasis is on transmitter operation in the region 8 to 10 GHz, and the components considered are IMPATT diode amplifiers, and TRAPATT diode and LSA diode oscillators. These components may be considered for use as driver stages to tube output stages or as transmitters in all solid-state radars. The potential role and present status of each of these devices is examined, and their performance in terms of parameters relevant to radar transmitter operation is described. Results are presented on IMPATT amplifiers with up to 6W CW power output and up to 20W peak power output over a 4 microns pulses, TRAPATT oscillators capable of 10W peak power output over 5 microns

pulses with high efficiency, and LSA oscillators with 1000W peak power output over 250 ns pulses. Author

N77-22348# Mullard Research Labs., Red Hill (England).
A CHEAP LOW NOISE (2.5 dB) X-BAND AMPLIFIER
R. E. Pearson *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 8 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Thin film techniques were applied to the design of a room temperature X-band amplifier to produce a unit which combines simplicity and low cost with the following performance: frequency: low X-band, gain: 15 dB, bandwidth (3dB): 100 MHz, and noise figure: 2.5 dB max. The unit is, with the exception of the Ka band Gunn pump, constructed completely by thin film techniques; complete with temperature stabilization circuitry, it measures 50 mm x 60 mm x 20 mm and can weigh as little as 200 grams. Bandwidths up to 500 MHz and noise figures as low as 1.9 dB were achieved. Author

N77-22349# Laboratoires d'Electronique et de Physique Appliquee, Paris Limeil-Brevannes (France).
LOW NOISE TRANSISTOR AMPLIFIERS [AMPLIFICATEUR BAS BRUIT A TRANSISTORS F. E. T. au GaAs]
P. Baudet, M. Parisot, and R. Veilex *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 15 p refs In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A study of amplifiers for military use is presented. The following are described and discussed: (1) the application of components; (2) electrical characterization; (3) conception and application of the amplifier; and (4) results. Transl. by B.B.

N77-22350# Varian Associates, Palo Alto, Calif.
NEW ADVANCES IN RELIABILITY AND EFFICIENCY IN LIGHTWEIGHT TWTs
Robert Berry and Armand Staprans *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 16 p (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The most commonly used microwave power amplifier in recently developed airborne radars is the coupled-cavity traveling wave tube. This tube is favored because of its large bandwidth, high peak and average power capability, high gain, and good signal purity. A number of recent developments were concerned with improvement of the special characteristics important for airborne use such as reliability, efficiency, small size and weight, and simplicity of power supplies. Recent developments and the various trade-offs for these areas are covered. Author

N77-22351# EMI-Varian Ltd., Hayes (England).
BROAD BAND MEGAWATT KLYSTROM AMPLIFIER: UTILIZING AN OVERLAPPING-MODE-EXTENDED INTERACTION OUTPUT SECTION
D. Perring, G. Phillips, and M. J. Smith *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 7 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A description of theory, design, and performance of an overlapping mode extended interaction output section for an S-band one megawatt pulsed klystron amplifier is reported. The device has a broader bandwidth performance than the double tuned output version and a simpler construction than a hybrid tube. The theoretical design predictions are compared with the practical results. Author

N77-22352# AEG-Telefunken, Ulm (West Germany).
A HIGH POWER PIN DIODE PHASE SHIFTER IN X-BAND WAVEGUIDE
C. H. Hamilton *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 13 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A new type of polarization phase shifter is described which was developed for a habour radar. It employs the inherent reactance of the PIN diode in a loaded-line type structure to produce the desired phase shift. Low impedance ridged waveguide and large volume diodes are used resulting in a design capable of considerably higher power handling capacity than has so far been reported for diode phase shifters in X-band. At the same time, the advantages of fast switching and low temperature sensitivity compared with presently available ferrite phase shifters were retained. Author

N77-22353# Lignes Telegraphiques et Telephoniques, Conflans-Sainte-Honorine (France). Dept. Hyperfrequence.
NEW HYPERFREQUENCY EMISSION PLUG-IN UNIT - RECEPTION FOR MILLIMETER RADAR WAVES [NOUVEAUX SOUS ENSEMBLES HYPERFREQUENCE EMISSION - RECEPTION POUR RADARS AUX ONDES MILLIMETRIQUES]
B. Chiron, J. R. Mahieu, and M. Fache *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 14 p In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The utilization of centimeter waves in microelectronic technology is discussed, which permits the suppression of coupling elements, the diminishing of tuning, and reduction of clutter. A dielectric resonator in which the temperature is stabilized is examined. Transl. by B.B.

N77-22354# Royal Radar Establishment, Malvern (England).
A SURVEY OF THE USE OF SURFACE WAVE DEVICES IN RADAR SYSTEMS
J. D. Maines and E. G. S. Paige *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 13 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

During the past decade, surface acoustic wave devices have emerged as important signal processing components which are particularly well suited to radar. The range of components which were developed and their applications in radar were reviewed. There were several significant achievements, most notable among them being the establishment of the use of SAW dispersive delay lines as the method for waveform generation and matched filtering in pulse compression systems. Author

N77-22355# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ANALOG MEMORY CORRELATORS FOR RADAR SIGNAL PROCESSING
Ernest Stern *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 13 p refs Sponsored in part by the Army and ARPA (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Acoustoelectric convolvers, memory correlators, and coherent integrators are being developed for spread-spectrum communication and radar systems. Performance details of each of these devices is given, and their potential utility for radars is assessed. Memory-correlators were realized which perform the functions of storing a reference waveform for a time-interval as long as 50 msec, and of cross-correlating subsequent signals with the stored reference. In a radar, a sample of the transmitted pulse is stored in the device, and radar echoes from targets subsequently correlate with a sample of the actual transmitted signal. Author

N77-22356# Siemens A.G., Munich (West Germany).
MTI-FILTERS USING SERIAL ANALOGUE MEMORIES
W. Kothmann *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 10 p (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

An attempt was made to extend the attainable dynamic range of the filters for a given signal resolution by suitable modification of the transfer function, by splitting into subsystems and by suitably combining the subsystems with each other. By limiting the costly arithmetic units to the absolutely necessary, an endeavour was made to arrive at solutions with the minimum number of components, with low dissipations and maximum circuit transparency. By using recently developed technologies, attempts were made to obtain solutions requiring less space and less power with simultaneously increased filter operating speed. In this context, it was possible to increase the speed of A/D converters, which represent the weakest link in a digital MTI filter, and favorable solutions were found for the design of multipliers in the filter sections. Author

N77-22357# Selenia S.p.A., Rome (Italy).
A REAL-TIME FFT PROCESSOR FOR RADAR
A. Costanzi, S. Diouonzo, G. Galati, and P. Neri *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The general features of FFT (Fast Fourier Transform) algorithm are briefly exposed, and the behavior of an FFT processor in data filtering is summarized. The problems connected to FFT processing in pulse-Doppler radars are described. The FFT processor's prototype and its testing procedures are briefly described. Author

N77-22358# EMI Electronics Ltd., Feltham (England).
DIGITAL PROCESSING TECHNIQUES AND EQUIPMENT. A REVIEW
P. V. Coates *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Advances in semi-conductor technology are continually opening new areas of application for digital systems. One of these areas is in the processing of video information derived from radar and other sensors prior to its display. The data format and the visual image are modified and synthetic information is inserted, either externally or internally generated, by the use of digital techniques. This enables an operator to obtain more useful information in a shorter time than was possible by displaying the image directly from the sensor output. Some of these techniques are described together with simple block diagrams of various equipment which perform this processing. A versatile digital equipment is described which uses a microprocessor to enable the single machine to be used to perform a wide variety of algorithms on the video outputs from many different sensors, in real time, by means of simple software modifications. Author

N77-22359# Shape Technical Center, The Hague (Netherlands).
DESIGN AND FIELD TESTING OF A DIGITAL AREA MTI-PLOT EXTRACTOR
J. Dekker *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 15 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A non-supervised, non-parametric learning algorithm is described, which, incorporated in an automatic radar data extraction system, has the ability to maintain a given constant false rate in an a priori unknown and changing, clutter and interference environment. The actual performance of a thus implemented extraction system is demonstrated by the results of operational field tests and by a series of long-term extracted plot histories of recorded video signals from a variety of radar stations in Europe. Author

N77-22360# Lincoln Lab., Mass. Inst. of Tech., Lexington.
MOVING TARGET DETECTOR, AN IMPROVED SIGNAL PROCESSOR
C. E. Muehe *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p refs (For primary document see N77-22346 13-32)
(Contracts F19628-76-C-0002; DOT-FA72WAI-242)
Avail: NTIS HC A25/MF A01

A three-year program directed toward radar improvements in an automated, air traffic control environment has successfully produced a practical radar signal processor which overcomes clutter effects and provides automatic acquisition and tracking of all aircraft within the radar antenna's field of view. The new digital processor, called the Moving Target Detector (MTD) was carefully evaluated, both theoretically and experimentally on an S-band Airport Surveillance Radar. The MTD radar exhibits a 50-dB improvement factor in ground clutter, a subweather visibility better than 12 dB, and complete elimination of second-time-around echoes. A ground clutter map gives the radar super- and intra-clutter visibility even on tangential aircraft (zero radial velocity). Author

N77-22361# Rome Air Development Center, Griffiss AFB, N.Y.
LOW ANGLE TRACKING TECHNIQUE
Kenneth C. Stiefvater *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 21 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The process enables the radar to track targets in elevation in the low-angle region between one beam width and the horizon. The technique uses the array facility to form two beams and a two-channel receiver system which forms the ratio of the signals from each beam. By design, this ratio is proportional to target elevation angle. The antenna patterns are designed to suppress the multipath signal energy, but residual image signal energy entering the receiver is processed with the target signal without degradation of system performance. This technique was implemented and tested on an overwater range using an aircraft as the test target to gather data and evaluate system performance under varying reflective surface conditions. The system operated at 5.5 MHz and used a 12-foot array aperture. Author

N77-22362# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
RADAR CROSS SECTION ANALYSIS AND TARGET IMAGING FROM THE DOPPLER INFORMATION IN THE RADAR ECHO
G. Graf *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 8 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The Doppler frequency spectrum of the radar echo from a rotating target with high resolution yields the distribution of the scattering centers in a cross range direction. The relation between Doppler spectra and the location of the scattering centers on a target is discussed and the optimum aspect angle window (integration time) that yields optimum resolution in the spectrum is given. Some experimental results show that Doppler frequency analysis is a useful tool in the analysis of the scattering properties of complicated targets. Author

N77-22363# Thomson-CSF, Malakoff (France).
LATERAL BEAM RADAR UTILIZING A SYNTHETIC ANTENNA [RADAR A FAISCEAU LATERAL UTILISANT UNE ANTENNE SYNTHETIQUE]
J. Genuist *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 15 p In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Utilization of lateral beam radar to obtain a high resolution image is discussed. A chart of definition is provided to identify natural and artificial topographical details of the region an aircraft is flying over. Transl. by B.B.

N77-22364# Admiralty Surface Weapons Establishment, Portsmouth (England).
RADAR TRACK EXTRACTION SYSTEMS
A. L. C. Quigley, J. E. Holmes, and R. J. Tunnicliffe *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 19 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The main constituents of a largely automatic radar track-while-scan system are described. It contains a plot extractor, clutter map, stationary plot filter, and automatic tracking software. The system is designed to operate in high false alarm conditions without formation of false tracks. The clutter map is used to select the optimum video for processes by the plot extractor, which is of fairly conventional design using cell-averaging CFAR and single level quantization. The plot extractor output has the majority of land clutter removed by the stationary plot filter and remaining plots are used in the formation and updating of tracks. The track updating algorithms are based on adaptive Kalman filters with various arithmetic simplifications for efficient computer processing. Author

N77-22365# AEG-Telefunken, Ulm (West Germany).
PLOT EXTRACTOR AND DATA PROCESSING EQUIPMENT FOR A MOBILE HIGH RESOLUTION 3D PENCIL-BEAM RADAR
Ing. Heinz Ebert *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 12 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The principle of sequential 3D scanning of the airspace by means of a pencil-beam antenna pattern, for reasons of complexity, is particularly suited for a highly mobile 3D air surveillance radar of high resolution. Advanced radar concepts of this type are using antennas with simultaneous electronic and mechanical beam scanning. For plot extraction, a procedure specially tailored to pencil-beam-scanning and having the following basic features is used: (1) signal amplitude evaluation, (2) target detection within the elevation scan (sliding window), and (3) center azimuth determination by means of an associative processor. Author

N77-22366# ITT Gilfillan, Inc., Van Nuys, Calif.
TECHNIQUES FOR AUTOMATIC TARGET DETECTION IN SCANNING 3-D RADAR
D. E. Hammers *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 21 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Rigorous methods are presented for characterizing and analyzing sliding gate, automatic target detection functions for 3-D scanning radars. Established detection techniques do not accurately apply to this problem since they do not account for correlation properties associated with the sliding action of the gate in relation to the azimuth-elevation hit pattern. A typical approach considered Monte Carlo computer simulation to iteratively derive the best automatic target detection function. However, this method can incur excessive computer time and manhours if the model has not been initially derived in consideration of correlation properties of the sliding gate. Through a stochastic difference equations approach, it is shown that the desired detection function is a Markov process and, as such, it is systematically derived relative to maximizing target sensitivity relative to false alarm requirements. As a result, overall radar performance and implementation costs are quickly assessed, leaving the investigation of scan modulation losses and target location accuracy to the more extensive resources required by the process of simulation. Performance curves and design methodology are generated for some particular examples for various target models. Author

N77-22367# Thomson-CSF, Malakoff (France).
NON-PARAMETRIC TESTS APPLIED TO RADAR [TESTS NON-PARAMETRIQUES APPLIQUES AU RADAR]
R. Carre *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 7 p In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The use of nonparametric tests in treating radar permits the reception of a constant false alarm independent of the potency or form of distribution of clutter. Optical radar is sampled and numerically coded. Values are stored in a memory on four successive repetitions. The test consists of analyzing selected signals in a gliding window. Strong signals are compared to determine the presence of a target. Performances are compared with those during classic tests and show that independence from noise characteristics is acquired without loss of important information. Transl. by B.B.

N77-22368# Forschungsinstitut fuer Hochfrequenzphysik, Werthhoven (West Germany).
PROBLEMS OF ADAPTIVE SIDELOBE SUPPRESSION
G. Ries and K. Kruecker *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 11 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Investigations dealing with decorrelation effects in a suboptimal spatial filter for adaptive interference suppression are presented. Degradation caused by decorrelation is partly determined by the antenna configuration, partly by mismatch between the receiving channels. Additional degradation caused by the target signal and by correlator offset errors in the adaptive control loops are discussed, too. Results of a special experimental system are also given. Author

N77-22369# Royal Signals and Radar Establishment, Malvern (England).
PHASE COMPARISON MONOPULSE APPLIED TO SECONDARY SURVEILLANCE RADAR
Brian A. Wyndham *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 18 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Developments in future civilian Secondary Surveillance Radar (SSR) Systems are being aimed at increasing the amount as well as the integrity of information exchanged between the ground station and the interrogated aircraft, while reducing the actual interrogation rate to the minimum necessary for reliable performance. The ultimate reduction would be to a single interrogation made only in the expected direction of an aircraft. Such extreme measures reduce the overall interference problem and improve message reliability, but make it necessary to adopt some technique for azimuth measurement other than the sliding window plot extractor usually used. The simplest solution to the problem is the use of monopulse designed to yield off axis measurements of the azimuth of transponder signals. A brief discussion along with the results of the initial phase of the experiments aimed at comparing the performance of alternative processes are also reported. Author

N77-22370# Societe d'Etudes et de Constructions Electroniques, Paris (France).
IFF IDENTIFICATION IN ZONES WITH HIGHLY CONCENTRATED INTERROGATION [IDENTIFICATION IFF DANS LES ZONES A FORTE CONCENTRATION D'INTERROGATEURS]
F. X. Pruvot *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 10 p refs In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The limitations of the secondary surveillance radar system are presented. Theoretical study of different configuration zones of a strong concentration of interrogators permits the approximate evaluation of the importance of perturbations affecting a given surveillance network. Some of the following are also discussed: (1) response rate of the responder; (2) failures; and (3) elementary treatment of responses. Transl. by B.B.

N77-22371# Manchester Univ. (England). Dept. of Electrical Engineering.
THE CASCADE REALIZATION OF M.T.I. FILTERS WITH STAGGERED P.R.F. AND TIME VARIABLE WEIGHTS
H. W. Thomas and T. M. Abram *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 15 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Non-uniform sampling is used in conjunction with time varying coefficients in M.T.I. filters to extend the first blind speed of the system, without degradation of the stopband. A z-transform matrix notation is introduced which leads to a concise representation of cascaded time varying filter sections. It is shown that the cascade realization has certain advantages in terms of sensitivity to arithmetic wordlength and a step-by-step design procedure for such filters is described. The design of each section is based on the determination of coefficients to locate zeros in the z-plane for optimum rejection of the clutter spectrum. Author

N77-22372*# Kansas Univ., Lawrence. Remote Sensing Lab.
POOR-RESOLUTION SATELLITE OBSERVATIONS OF RADAR RETURN FROM NORTH AMERICA, BRAZIL, AND THE OCEANS
Richard K. Moore, Arun Sobti (Motorola, Inc., Schaumburg, Ill.), and James D. Young (General Dynamics, Ft. Worth, Texas) *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 19 p refs (For primary document see N77-22346 13-32)
(Contracts NAS9-13331; NAS9-13642)
Avail: NTIS HC A25/MF A01

The 13.9 GHz radar scatterometer on Skylab produced statistics of radar returns from thousands of points in North America and Brazil, as well as from the oceans. The resolution cell of the system varied from about 11 km in diameter at vertical incidence to 20 by 30 km at 50 deg incidence. Although these cells are larger than the preprocessing cells to be expected from spacecraft synthetic-aperture radars, they are at least as comparable with such cells as are the observation cells when aircraft radars are used. Results are presented both in terms of

composite statistics for North America, Brazil, and the oceans, and in terms of statistics for particular classes of terrain. Both vertical and horizontal polarization data are presented for the land, and cross-polarized measurements are presented as well as for the sea. Correlations are indicated for the returns at different angles and polarizations. Author

N77-22373# Physics Lab. RVO-TNO, The Hague (Netherlands).
CHARACTERISTICS OF CLUTTER AND TARGETS AT X- AND KU-BAND
H. Sittrop *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 26 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The radar backscatter of the sea per unit area, sigma 0, and the rms clutter velocity spread are described versus grazing angle and wind velocity by an experimental model. A thorough comparison is made with measurements and calculations. The obtained results justify the assumption that the model can be used in the so-called near grazing and in the plateau region. The two scatter mechanism of Bragg resonant capillary waves and small facets overlaying the shorter gravity waves is discussed. Characteristic ratios of sigma 0 are presented versus windvelocity. A multipath Radar Cross Section (RCS) approximation is given in a closed form and numerically, for a variety of target models and clusters. Optimum signal to clutter ratios are discussed for the detection of buoys by shipping-traffic. Characteristics of arbitrarily chosen target clusters are simulated and typical discrepancies between clutter and target scintillations are demonstrated. The influence of precession, nutation, and rotation on the radar backscatter, due to irregularities of a body of revolution, is shown. Results of dynamic, in flight, measurements and simulations based on static measurements are included. Clutter and target model application may contribute in finding an optimum combination of relevant and environmental parameters. Author

N77-22374# Malibu Research Associates, Santa Monica, Calif.
A REAL-TIME RADAR ENVIRONMENT SIMULATION
G. E. Pollen and J. F. Walker (Technol. Service Corp., Santa Monica, Calif.) *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

An approach to radar development and testing using real-time signal simulation was developed and successfully demonstrated in the development of a major phased-array radar system. The concept makes use of a real-time Radar Environment Simulation System (RESS) to serve as a test bed for the development and test of the host radar. The RESS generates target and clutter environment signal returns for insertion into the radar front-end video signal stream. The main feature of the RESS concept is its direct application of realistic target and clutter models to radar testing. Complex environmental models are used in an off-line general purpose computer to generate signal control tapes, which are used in an on-line, real-time signal simulation unit. The on-line system is interactive with the radar, i.e., it generates signal modulations due to beam scanning and transmitted waveform in realtime on cue from the radar transmission. Target characteristics which are reflected in the RESS outputs signals include detailed prescribed trajectories and RCS fluctuation models. Over 100 independent targets can be generated thus simulating a highly complex test environment. Clutter properties include spectral shapes, amplitude fluctuation, and spacial non-homogenities. Clutter types include ground, rain, and false targets. Author

N77-22375# Shape Technical Center, The Hague (Netherlands).
RECONSIDERATION OF THE TARGET DETECTION CRITERION BASED ON ADAPTIVE ANTENNA POLARIZATIONS
A. J. Poelman *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 14 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The target detection problem is reconsidered taking into account the polarization state of the target backscattered and interference fields. Radar object backscattering in terms of its scattering matrix was reviewed. As the polarization state of an electromagnetic wave is a carrier of information, its employment may result in an improved target detection capability of the radar system, both in natural and man-made interference environments. Adaptive suppression of unwanted signals by means of proper matching of the antenna polarizations at transmit and receive is considered along with consequent improvement in average target signal power to average unwanted signal power ratio at the input of the detection receiver. As the adaptive schemes require significant digital processing, the applicability in particular in those areas, where a limited number of radar cells need to be treated simultaneously, e.g. in tracking radars, is studied. Author

N77-22376# Electronique Marcel Dassault, St. Cloud (France).
A METHOD FOR NUMERICALLY CALCULATING THE PROBABILITY OF DETECTING FLUCTUATING SIGNALS [METHODE DE CALCUL NUMERIQUE DE PROBABILITE DE DETECTION DE SIGNAUX FLUCTUANTS]
P. Blondy *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The following methods for the calculation of probability detection were examined: (1) approximation by the Gram Charlier series; (2) inversion of the characteristic function by discrete Fourier transformation; and (3) inversion of the characteristic function by the calculation of residue. Transl. by B.B.

N77-22377# ITT Gilfillan, Inc., Van Nuys, Calif.
SIMULATION OF A RADAR TRACKING A GLINTING AIRCRAFT TARGET IN A MULTIPATH ENVIRONMENT
Jay H. Landreth *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 23 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Models of a radar, the target, and the terrain are developed for the Fresnel field range so that a radar designer can optimize a radar when tracking is required at short ranges near the ground. Those features of the radar that effect target information or the processing of it are part of the radar model. The target is assumed to be an ensemble of simple shaped scatterers while the roughness of the terrain is represented by a statistically rough surface and a slightly rough surface. A coherent time summation of the signals received from the direct and indirect signal paths are formed into a range facsimile of the real signal. A two channel receiver and processor were emulated to process the data. An application of the model was developed into a computer simulation in which a pencil beam radar employs three dimensional tracking. Author

N77-22378# Lincoln Lab., Mass. Inst. of Tech., Lexington.
COHERENT INFRARED RADAR
Robert H. Kingston and Leo J. Sullivan *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 8 p refs Sponsored by ARPA (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A coherent radar system operating at a wavelength of 10.6 micrometers or approximately 0.01 mm, using an ultra-stable CO2 laser oscillator and one kilowatt amplifier is described. Although limited to clear weather conditions, the high Doppler sensitivity, 2 kHz/cm/sec, and narrow beamwidth, 10 microradians result in extremely precise velocity and angle measurements. The critical components of the system are reviewed as well as the special properties and techniques peculiar to this wavelength region. The overall system is described as well as recent experiments utilizing the retroreflector-equipped GEOS-C satellite. Author

N77-22379# Compagnie Industrielle des Lasers (France).
LASER APPLICATIONS IN RADAR TECHNIQUES [APPLICATIONS DU LASER DANS LE DOMAINE DES TECHNIQUES RADAR]
P. Trevoux *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 10 p refs In FRENCH (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Laser applications are described for the following: (1) guidance on a target indicated by a laser; (2) aircraft trajectory with automatic pursuit; and (3) the direction and the pursuit of low targets in the center of anti-aerial defense. Transl. by B.B.

N77-22380# Norden, Norwalk, Conn.
MILLIMETER WAVE MONOPULSE TRACK RADAR
Lester H. Kosowsky, Kenneth L. Koester, and Robert S. Graziano *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 17 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

A high accuracy millimeter wave monopulse radar was developed for use in high resolution tracking applications. The system utilizes a real aperture millimeter wave antenna transmitting a medium power noncoherent narrow pulse. An analysis of attenuation and backscatter in adverse weather conditions indicates that against a 10 square meter target, a range of 10 km may be obtained in clear air and 4.8 km in 4 mm/hr or rain. A description of the system configuration is given together with currently available experimental data. Accuracies of better than 1.0 mr were achieved. Author

N77-22381# Forschungsinstitut fuer Funk und Mathematik, Werthoven (West Germany).
THE ELRA PHASED-ARRAY RADAR WITH AUTOMATIC PHASE ADJUSTMENT IN PRACTICE
G. Hueschelrath and W. Sander *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 11 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The Electronic Steerable Radar system is described along with presently implemented parts. First experimental results are also given. Author

N77-22382# BDM Corp., Albuquerque, N.Mex.
WIDEBAND RADAR IMAGING AND SIGNAL PROCESSING ARRAY
Jiunn S. Yu and David T. Bailey *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 30 p refs (For primary document see N77-22346 13-32)
(Contracts F30602-73-C-0343; F30602-73-C-0110)
Avail: NTIS HC A25/MF A01

Wideband coherent radar is capable of high-resolution target imaging. Similar to synthetic aperture radars used in terrain mapping, the analytical formulation of space-object scattering and imaging are developed. Three targets are selected to obtain their backscattering fields in computer simulation. Complex signal and spectral densities are then used to perform the image-synthesis procedure based on the Woodward method. Numerical examples are given to demonstrate resolution capability and image enhancement. The dispersive radiation field of LP (Log-Periodic) antennas are also described, and the LP signal processing models based on the fractional bandwidth of radiating elements are examined. Elemental transfer functions of narrow-band signals are developed to synthesize the overall broadband-filter function for performing pulse compression. Compression gains for signal energy density are derived using the LP-phase model. Potential performance of combining the image synthesis and LP-signal processing are briefly discussed in terms of signal resolutions, frequency agility, and waveform diversity. Author

N77-22383# Selenia S.p.A., Rome (Italy).
MULTIBEAM MONOPULSE ARRAY ANTENNA WITH INDEPENDENT ELEVATION BEAM SCANNING
B. Palumbo and A. Cucci *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 21 p refs (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

The antenna solution was chosen after a trade-off study and experimental verification of the achievable performances. The antenna beams are independently scanned in elevation and independent optimization of the sum and difference illumination distribution for high performance monopulse operation is provided. Use is made of an RF matrix comprising a center dual series-feed network for each beam. Diode and ferrite phase shifters perform the scanning of the beams, each in its angular sector of the coverage elevation angle. A set of stacked linear arrays of radiating elements, each fed by a power dividing network, in a planar array configuration, is utilized for the asimuthal beam forming. Author

N77-22384# Royal Signals and Radar Establishment, Malvern (England).
SECONDARY RADAR FOR AIRFIELD GROUND MOVEMENT MONITORING
H. N. Griffiths *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 19 p Sponsored in part by the Civil Aviation Authority (London) (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

Secondary radar is used for the in-flight identification of aircraft. An extension of the secondary radar technique is suggested for the identification and location of aircraft taxying on the airfield surface. This has sufficient positional accuracy for use alone or for the labelling of a high definition primary radar display of airfield ground movements. The results of trials on an airfield site are discussed and experiments to determine the effects of ground reflections and aircraft self screening are described with polar diagrams of selected aircraft. Accurate position finding using trilateration is discussed. Author

N77-22385# Norwegian Defence Research Establishment, Kjeller.
RADAR WIND MEASUREMENT SYSTEM
S. Rosenberg *In* AGARD New Devices, Tech. and Systems in Radar Feb. 1977 9 p ref (For primary document see N77-22346 13-32)
Avail: NTIS HC A25/MF A01

An all solid state low power X-band radar for wind profile determination in the lower atmosphere is described. Measurements of wind velocity and direction are made by tracking a balloon-borne corner-reflector. Angle tracking is performed manually with the aid of the angle error signal which is presented on a liquid crystal display. A Gunn oscillator/Impatt amplifier combination gives a 1 to 2 W output which is biphase modulated using Barker and modified Barker codes. A correlation receiver with double IF is used, the active demodulation being performed in the second mixer. Video integration is performed digitally by a microcomputer which also guides target acquisition and range tracking. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N77-22386* National Aeronautics and Space Administration. Pasadena Office, Calif.
ARC CONTROL IN COMPACT ARC LAMPS Patent
Charles G. Miller (JPL) and Ralph E. Bartera, inventor (to NASA) (JPL) Issued 29 May 1973 10 p Filed 22 Jan. 1971 Sponsored by NASA
(NASA-Case-NPO-10870-1; NASA-Case-NPO-11191-1; NASA-Case-NPO-11403-1; US-Patent-3,736,453; US-Patent-Appl-SN-1-881-; US-Patent-Class-313-146; US-Patent-Class-313-60; US-Patent-Class-313-182) Avail: US Patent Office CSCL 09A

An invention which relates to several methods designed to stabilize the operation of arc lamps, and to increase the handling capacity and light output of these lamps is described. It allows a single anode lamp to function as efficiently, in terms of power handling capacity, as the complete multi-anode lamp. In one aspect of the invention, magnetic field means are used to control the location of the arc attachment points on the electrodes. Furthermore, the magnetic field is used to move the attachment points of the arc on the anode in a predetermined manner that will greatly improve the usefulness and output of a lamp. In order to take full advantage of this capability, yet another aspect of the invention relates to an internal cooling circuit designed to provide increased cooling efficiency to a larger and selected area of the anode tip.
Official Gazette of the U.S. Patent Office

N77-22387 California Univ., Davis.
A STATISTICAL APPROACH TO EDGE EXTRACTION IN

SAMPLED IMAGES Ph.D. Thesis
Gary Evan Ford 1976 269 p
Avail: Univ. Microfilms Order No. 77-6333

The problem of edge extraction in sampled images is in formulated as a statistical estimation and detection problem. Known methods of statistical inference are applied to the problem, providing insight into the nature of edge extraction. Practical edge extraction algorithms are designed and applied to several images. Employing a formal approach to edge extraction, the fundamental requirements and objectives of edge extraction are defined, and a two-dimensional image model is formulated. Edges are characterized as boundaries between image regions having homogeneous statistical properties, and the locations of edges become parameters in the model. Dissert. Abstr.

N77-22388*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRIC VEHICLE POWER TRAIN INSTRUMENTATION: SOME CONSTRAINTS AND CONSIDERATIONS
James E. Triner and Irving G. Hansen 1977 21 p refs Presented at Intern. Elec. Vehicle Exposition, Chicago, 26-29 Apr. 1977; sponsored by Elec. Vehicle Council
(Contract EC-77-A-31-1011)
(NASA-TM-X-73629; E-9125; ERDA/NASA-1011/77/1) Avail: NTIS HC A02/MF A01 CSCL 09A

The application of pulse modulation control (choppers) to dc motors creates unique instrumentation problems. In particular, the high harmonic components contained in the current waveforms require frequency response accommodations not normally considered in dc instrumentation. In addition to current sensing, accurate power measurement requires not only adequate frequency response but must also address phase errors caused by the finite bandwidths and component characteristics involved. The implications of these problems are assessed. Author

N77-22389*# Varian Associates, Palo Alto, Calif.
PHOTOMULTIPLIER TUBE DEVELOPMENT FOR THE 1.06 MICROMETER WAVELENGTH Final Report, Mar. 1973 - Apr. 1975
R. S. Enck, Jr. Mar. 1976 75 p refs
(Contract NAS5-23215)
(NASA-CR-152491) Avail: NTIS HC A04/MF A01 CSCL 09A

High speed, electrostatic photomultipliers were developed for use in 400 megabit laser communication systems operating at the 1.06 micron wavelength. A high performance, electrostatic III-V photocathode PMT was shown in communication system tests to perform competitively with solid state and avalanche photodiodes. Signal-induced noise and III-V cathode stability were identified as remaining technical problems while cathode quantum efficiencies of > or = 5% at 1.06 micron and 320 picosecond rise and fall time pulse performance were achieved. Author

N77-22390*# Varian Associates, Palo Alto, Calif.
HIGH SPEED ELECTROSTATIC PHOTOMULTIPLIER TUBE FOR THE 1.06 MICROMETER WAVELENGTH. CUP AND SLAT DYNODE CHAIN COMBINED WITH FLAT CATHODE AND COAX OUTPUT PRODUCES 0.25 nsec RISE TIME Final Report, May 1972 - Jan. 1973
Stephen D. Sparks 18 Apr. 1973 22 p
(Contract NAS5-23110)
(NASA-CR-152494) Avail: NTIS HC A02/MF A01 CSCL 09A

The Varian cup and slat dynode chain was modified to have a flat cathode. These modifications were incorporated in an all-electrostatic photomultiplier tube having a rise time of 0.25 n sec. The tube delivered under the contract had a flat S-20 opaque cathode with a useful diameter of 5 mm. The design of the tube is such that a III to V cathode support is mounted in place of the existing cathode substrate. This cathode support is designed to accept a transferred III to V cathode and maintain the cathode surface in the same position as the S-20 photocathode. Author

N77-22391*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT AND PERFORMANCE OF POWER PROCESSOR SYSTEM FOR 2-GIGAHERTZ, 200-WATT AMPLIFIER FOR COMMUNICATIONS TECHNOLOGY SATELLITE
Clifford E. Siegert, Francis Gourash, and Richard W. Vasicek Washington May 1977 41 p refs
(NASA-TM-X-3516; E-8893) Avail: NTIS HC A03/MF A01 CSCL 09A

The electrical and environmental requirements for a power processor system (PPS) designed to supply the appropriate voltages and currents to a 200-watt traveling wave tube (TWT) for a communication technology satellite is described. A block diagram of the PPS, the interface requirements between the PPS and spacecraft, the interface requirements between the PPS and 200-watt TWT, and the environmental requirements of the PPS are presented. Also included are discussions of protection circuits, interlocking sequences, and transient requirements. Predictions of the flight performance, based on ground test data, are provided. Author

N77-22392# California Univ., Berkeley. Lawrence Berkeley Lab.
COMPUTER MODEL FOR NOISE IN THE dc SQUID
C. D. Tesche and John Clarke Aug. 1976 4 p refs Presented at Appl. Superconductivity Conf., Stanford, Calif., 17-20 Aug. 1976
(Contract W-7405-eng-48)
(LBL-5461; Conf-760829-31) Avail: NTIS HC A02/MF A01

A computer model for the dc SQUID is described which predicts signal and noise as a function of various SQUID parameters. Differential equations for the voltage across the SQUID, including the Johnson noise in the shunted junctions, are integrated stepwise in time. ERA

N77-22393# California Univ., Berkeley. Lawrence Berkeley Lab.
RESISTANCE OF SUPERCONDUCTING-NORMAL METAL-SUPERCONDUCTING SANDWICHES Ph.D. Thesis
M. L. Rappaport Sep. 1976 200 p refs
(Contract W-7405-eng-48)
(LBL-5473) Avail: NTIS HC A09/MF A01

The resistance, R, of superconducting-normal, metal-superconducting (SNS) sandwiches was measured as a function of temperature, T, and measuring current, I, usually from 20 mK to T/sub cS/. A semi-phenomenological theory for the resistance of these sandwiches below T less than or or equal to 1 K which includes both temperature and current dependence was derived using the de-Gennes theory of the proximity effect and the idea of Andreev reflection. Comparing experimental and theoretical R vs T curves for T less than or equal to 1 K allows estimation of the magnitude of the pair potential in N. ERA

N77-22394# Ames Lab., Iowa.
NEDR: A COMPUTER PROGRAM FOR CALCULATING ac LOSSES IN A TYPE-2 SUPERCONDUCTOR WITH A FIELD-DEPENDENT SURFACE BARRIER
N. C. Rouze and J. R. Clem Aug. 1976 48 p refs
(Contract W-7405-eng-82)
(IS-4017) Avail: NTIS HC A03/MF A01

Numerous quantities associated with the losses can be calculated, including the magnetic field and flux density profiles, the surface, bulk-pinning, and bulk-annihilation contributions to the losses, the spatial dependence of the bulk losses, and the net energy loss per cycle. The program is constructed such that the critical current density J/sub c/, field H/sub eq/, the critical energy field H/sub en/, and the critical exit field H/sub ex/ as functions of the flux density B are written as subprogram functions and may be easily changed for different models. ERA

N77-22395# General Electric Co., St. Petersburg, Fla. Neutron Devices Dept.
VACUUM ARC ANODE PHENOMENA
H. C. Miller 3 Nov. 1976 43 p refs
(Contract EY-76-C-04-0656)
(GEPP-264) Avail: NTIS HC A03/MF A01

A brief review of anode phenomena in vacuum arcs is presented. The transition of the arc into the anode spot mode, the temperature of the anode before, during, and after the anode spot forms, and anode ions are discussed. Characteristically the anode spot has a temperature of the order of the atmospheric boiling point of the anode material and is a copious source of

vapor and energetic ions. The dominant mechanism controlling the transition of the vacuum arc into the anode spot mode appears to depend upon the electrode geometry, the electrode material, and the current waveform of the particular vacuum arc being considered. Either magnetic constriction in the gap plasma or gross anode melting can trigger the transition. ERA

N77-22396# Los Alamos Scientific Lab., N. Mex.
PASSIVE NOTCH CIRCUIT FOR PULSED-OFF COMPRESSION FIELDS
W. C. Nunnally Jun. 1976 6 p
(Contract W-7405-eng-36)
(LA-6403) Avail: NTIS HC A02/MF A01

The operation and simulated results of a passive notch circuit used to pulse off the field in a multiturn, fusion power system, compression coil are presented. The notch circuit permits initial plasma preparation at field zero, adiabatic compression as the field returns to its initial value, and long field decay time for plasma confinement. The major advantages and disadvantages of the notch circuit are compared with those of a standard capacitor power supply system. The major advantages are that: (1) slow rising fields can be used for adiabatic compression; (2) solid state switches can be used because of the inherent current and voltage waveforms; and (3) long field decay times are easier to attain than with single-turn coils. ERA

N77-22397# Sandia Labs., Albuquerque, N.Mex.
MAGNESIUM ALLOY SOLID ELECTROLYTIC CAPACITORS
R. G. Dosch and T. S. Prevender Jan. 1974 11 p refs
(Contract E(29-1)-789)
(SLA-74-0038) Avail: NTIS HC A02/MF A01

Solid electrolytic capacitors consisting of magnesium alloy AZ31B and gold electrodes separated by a MgF(2) dielectric film were prepared. The dielectric films (less than 10,000 A thick) are formed electrolytically on the AZ31B surface in a nonaqueous electrolyte. The electrolyte composition, procedure used in forming the dielectric films, and some physical and electrical characteristics of both the films and the completed capacitors are discussed. ERA

N77-22398# TRW Defense and Space Systems Group, Redondo Beach, Calif.
DEVELOPMENT PROGRAM FOR SOLID ELECTROLYTE BATTERIES Final Report, 1 Jul. 1975 - 30 Apr. 1976
Herbert P. Silverman, Lynn S. Marcoux, and Eddie T. Seo Sep. 1976 104 p refs
(PB-260719/0; EPRI-EM-226) Avail: NTIS HC A06/MF A01 CSCL 10C

The results of sodium-sulfur battery program are presented. The long-range objective of the program was the development and commercialization of sodium-sulfur battery for electric utility energy storage. The study demonstrated that the major challenges of developing the sodium-sulfur battery into a commercially viable energy-storage system are: (1) development of corrosion resistant sulfur-electrode containers; (2) design and development of a less highly stressed seal; (3) fabrication of long-life electrolytes; and (4) design of cells capable of full utilization of the active positive-electrode material (sulfur). GRA

N77-22399# Army Electronics Command, Fort Monmouth, N.J.
ELECTRON SOURCES FOR FUTURE IMAGE TUBES Final Report, Sep. 1971 - May 1973
Terry L. Jones Jun. 1976 38 p refs
(DA Proj. 1T0-61102-A-31B)
(AD-A032049; ECOM-7054) Avail: NTIS HC A03/MF A01 CSCL 17/5

Several electron sources were investigated for use in far infrared image tubes in an effort to find or develop sources which had sharp cutoffs in their electron energy distribution curves (EDC's). An angular electron energy analyzer system was fabricated and used to evaluate not only EDC's but also their dependence on emission angle. Primary experimental attention was directed at two electrostatic filtering techniques - 127 deg. cylindrical and hemispherical, and three emitters - miniature field-emitter tips, tin oxide thin films, and negative electron affinity (NEA) gallium phosphide photoemitters. None of these were developed sufficiently for use in image tube applications. However, the field-emitter tips and NEA emitter look promising for improving the contrast enhancement in future image tubes. Author (GRA)

N77-22400# Mitre Corp., McLean, Va.
THE AIR-CORE LINEAR SYNCHRONOUS MOTOR: AN ASSESSMENT OF CURRENT DEVELOPMENT Final Report
C. A. Skalski Jun. 1976 144 p refs
(Contract DOT-FR-54090)
(PB-261770/2; MTR-7028; FRA-ORD/D-76-260) Avail: NTIS HC A07/MF A01 CSCL 13F

The development of the air-core linear synchronous motor (LSM) is examined. The outstanding performance features of these motors are demonstrated in terms of a simple theory, numerous design examples, and discussion of practical aspects. Comparisons to iron-core LSMs and linear induction motors are made. Also, the possibility of using air-core LSMs as an alternative to conventional railroad electrification techniques is pointed out. GRA

N77-22401# Army Electronics Command, Fort Monmouth, N.J.
PROCEEDINGS OF THE ECOM-ARO WORKSHOP ON ELECTRICALLY SMALL ANTENNAS
G. Goubau, ed. and F. Schwering, ed. Oct. 1976 236 p refs Conf. held at Fort Monmouth, N. J., 6-7 May 1976
(AD-A031845) Avail: NTIS HC A11/MF A01 CSCL 09/5

Antennas to be used for communication in Army tactical situations have to satisfy the requirements of low visibility and low vulnerability. At wavelengths in the HF and VHF ranges--the frequency bands commonly used for tactical radio communications--these constraints require the use of electrically small antennas. As is well known, the design of such antennas requires sophistication if acceptable electrical performance is to be achieved. The purpose of the workshop was to bring together antenna scientists from universities, industries, and government laboratories to discuss the capabilities, fundamental limitations, and design trade-offs of electrically small antennas, and to provide a forum for the presentation of new ideas for improving antenna performance. Special attention has been given to active antenna techniques, which up to now have not been used by the Army to a large extent, and to the problem of controlling or utilizing the interaction of electrically small antennas with complex platform environments such as provided by tanks, helicopters, and manpack sets. GRA

N77-22402# Cornell Univ., Ithaca, N.Y.
WIDE-BAND MICROWAVE AMPLIFIER REALIZATIONS IN MICROSTRIP EMPLOYING A GaAs SCHOTTKY-BARRIER FIELD-EFFECT TRANSISTOR Interim Report, 1974-1976
R. B. Watson, Jr. Griffiss AFB, N. Y. RADC Aug. 1976 162 p refs
(Contract F30602-74-C-0001)
(AD-A031428; RADC-TR-76-246) Avail: NTIS HC A08/MF A01 CSCL 09/5

This work deals with the realization of two 4-8 GHz flat-gain amplifier designs in microstrip using a single GaAs Schottky-barrier field-effect transistor. Two aspects of microstrip amplifier realization are considered. The first aspect is accurate realization of required lumped and distributed circuit elements. The second involves detailed mathematical modelling of practical circuit elements, permitting computer analysis and optimization of complete amplifier networks. After techniques for analysis and design of microstrip transmission lines are reviewed including loss and dispersion effects, particular areas of difficulty in practical design and fabrication of amplifiers are studied. These areas include microwave short circuit (DC open) realization using radial line sectors, fabrication of lumped inductors from Hewlett-Packard SBFET leads (Package 60), and circuit modelling of microstrip to coaxial transitions. Two versions of a simple amplifier design were built and measured on a Hewlett-Packard microwave network analyzer. A FORTRAN computer analysis program based on transmission scattering matrices was written to calculate the scattering parameters of ladder network models such as this first amplifier. The program aided in improving design methods such as the realization of lumped inductors. GRA

N77-22403# Illinois Univ., Chicago. Communications Lab.
TOPICS IN ADVANCED ANTENNA THEORY Interim Report
Giorgio Franceschetti Jul. 1976 91 p ref
(Grant AF-AFOSR-2263-72; AF Proj. 9749)
(AD-A031325; AFOSR-76-1128TR) Avail: NTIS HC A05/MF A01 CSCL 10/2

These lecture notes contain new research results in (1) antenna admittance and gap problem, (2) transient radiation from antennas, and (3) transform properties of radiated fields. Author (GRA)

N77-22404# Raytheon Co., Bedford, Mass. Missile Systems Div.
RELIABILITY EVALUATION OF SCHOTTKY BARRIER DIODE MICROCIRCUITS Final Technical Report, May 1974 - Jun. 1976
E. T. Lewis, D. Bartels, and A. A. Capobianco Sep. 1976 273 p refs
(Contract F30602-74-C-0213)
(AD-A032001; RADC-TR-76-292) Avail: NTIS HC A12/MF A01 CSCL 09/5

The objective of this study has been the analysis and reliability evaluation of modern Schottky Barrier Diode clamped microcircuits for use in high speed digital applications. The selected devices included SSI and MSI integration, single layer metallization, in both the regular and low power versions from two major vendors. All devices in the study utilized a trimetal system consisting of pure aluminum as the main conductor, titanium-tungsten as a barrier metal, and platinum-silicide for the Schottky and ohmic contacts. All devices were subjected to long term high temperature storage and high temperature static operation to establish activation energies and to calculate failure rates at maximum operating temperature ranges. The low power Schottky 54LS00 from both Vendors A and B were additionally subjected to dynamic long term accelerated testing for comparison purposes. Detail construction analysis and electrical characterization, including thermal resistances, were performed on all device types. Units which failed during the performance of life testing were electrically categorized and physically analyzed to establish failure modes and mechanisms. Author (GRA)

N77-22405# Syracuse Univ., N.Y. Dept. of Electrical and Computer Engineering.
A REACTIVELY LOADED APERTURE ANTENNA ARRAY
John Luzwick and Roger F. Harrington Sep. 1976 70 p refs
(Contract N00014-76-C-0225)
(AD-A031784; TR-76-10; TR-3) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report considers an array of reactively loaded aperture antennas, specifically, an N element array of closely-spaced waveguide-backed rectangular slots. Only the center waveguide is fed and the other waveguides are short circuited to provide the reactive loads. The positions of the short circuits are chosen to obtain maximum antenna gain in some specified direction. By varying the positions of the short circuits, a directive beam can be steered through 180 deg space. Both seven and nine element arrays are considered explicitly. Feasibility for physical realization of the reactive loading is discussed. A computer program with operating instructions is included. Author (GRA)

N77-22406# Varian Associates, Palo Alto, Calif. Microwave Tube Div.
KLYSTRON-TWT HYBRID EFFICIENCY IMPROVEMENT Final Technical Report, 16 Dec. 1974 - 30 Jun. 1976
Robert J. Butwell Aug. 1976 52 p refs
(Contract F30602-75-C-0080)
(AD-A031427; RADC-TR-76-257) Avail: NTIS HC A04/MF A01 CSCL 09/5

This final report covers effort from 16 December 1974 through 30 June 1976. The effort was expended as Phase II of a theoretical and experimental investigation of methods of improving the conversion efficiency of relatively broadband linear-beam amplifiers operating at approximately 1 MW of peak power. The Phase I 'short-stack' intense-interaction cloverleaf structure design was modified. Extensive cold testing was performed with an emphasis on selective loading of the higher-order modes that supported oscillations in the Phase I tube. Computer-aided calculations predicted 43% minimum efficiency over a 10% bandwidth with a midband efficiency of 56%. Performance was limited by an efficiency dip near the low end of the band, a gain hole in band, an RF drive-induced oscillation near saturation at some combinations of beam voltage and current, and a beam deduced to be of smaller diameter than was assumed in the calculations. Under the above conditions, the best saturation performance was 42% midband efficiency with a 1.5 dB bandwidth of 10%, and 50% midband efficiency with a 1.5 dB bandwidth of 6%. Constant RF drive results included 200 MHz of bandwidth with minimum efficiency of 33% and 36 dB gain at the 800 kW level, and 200 MHz of bandwidth with minimum efficiency of 34% and 37 dB gain at the 1100 kW level. Author (GRA)

N77-22407# Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
THEORY AND DESIGN OF ELECTRICAL ROTATING MACHINERY Annual Report, 1 May 1975 - 30 Apr. 1976
W. J. Carr, Jr. Sep. 1976 20 p refs
(Contract N00014-72-C-0432; NR Proj. 097-385)
(AD-A031592; AR-4) Avail: NTIS HC A02/MF A01 CSCL 09/3

The objective of the program is to contribute toward new and improved rotating machines for Naval applications, with emphasis on superconducting machinery. Work has been performed on the theory of ac losses in multifilament superconductors and experiments were made to check the theory. A list of publications and abstracts of scientific papers published under the contract is given. Some work is reported on a novel normal homopolar motor and some other novel machines. GRA

N77-22408# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
HIGH POWER STUDY, SUPERCONDUCTING GENERATORS Final Report, 2 Jun. 1975 - 1 Mar. 1976
A. E. King, C. C. Kouba, J. L. McCabria, and L. D. Smith 1 Mar. 1976 220 p refs
(Contract F33615-75-C-2068)
(AD-A031620; AFAPL-TR-76-37) Avail: NTIS HC A10/MF A01 CSCL 10/2

This report summarizes the results of a design study of light weight, high power electrical generators in the 10 to 50 Megawatt range with output voltages up to 200 kV dc (after rectification). Superconducting machines representing the latest technology were the focus of the study; non-superconducting machines utilizing the most advanced conventional design technologies were also studied to develop comparable performance data. Turbine requirements and integration features were studied to assure compatibility. A separate analysis of MHD electrical generator designs was also carried out to highlight comparable performance data for that type of power source. Author (GRA)

N77-22409# Young (Arthur) and Co., Washington, D. C.
GROUND-FAULT CIRCUIT PROTECTION: PRELIMINARY ASSESSMENT OF TECHNOLOGICAL FEASIBILITY AND ECONOMIC IMPACTS Final Report
22 Mar. 1976 102 p refs
(Contract DL-J-9-F-5-0134)
(PB-261036/8; OSHA-IIA-76-322) Avail: NTIS HC A06/MF A01 CSCL 13L

The two methods discussed, ground-fault circuit interrupters and an assured equipment grounding program, provide protection against line-to-ground fault currents. Both methods are effective in providing protection against the hazards of electric shock and electrocution. Overall economic impact is determined to be relatively slight. GRA

N77-22410# Rocketdyne, Canoga Park, Calif.
A 60-WATT POWER SOURCE Final Report, Apr. 1973 - Jan. 1976
J. A. Speeds and R. Spies Apr. 1976 121 p refs
(Contract F33615-73-C-4071)
(AD-A032076; R-9651; AFAPL-TR-76-44) Avail: NTIS HC A06/MF A01 CSCL 10/2

The feasibility of a 60-watt output dynamic power system contained in 6 cubic inches was demonstrated. A high-speed (300,000 rpm) turboalternator driven by the decomposition products from a hydrazine gas generator was developed for this application. Overall and component performance were determined

experimentally with GN2, and the program culminated with a series of demonstration tests with hydrazine and the delivery of a brassboard system. Author (GRA)

N77-22411# Picatinny Arsenal, Dover, N.J.
PRELIMINARY STUDIES ON PULSED ELECTRIC FIELD BREAKDOWN OF LEAD AZIDE
L. Avrami, M. Blais, D. Downs, and T. Gora Oct. 1976 27 p refs
(AD-A031905; PA-TR-4991) Avail: NTIS HC A03/MF A01 CSCL 19/1

Preliminary results from a study of the electric field induced breakdown of lead azide are reported. Specifically, the effects of contacts on the initiation of explosives by electric fields, and present preliminary measurements of the transient current in lead azide during the application of a pulsed voltage pulse are discussed. A circuit which eliminates the capacitive transient due to the voltage pulse is described. Author (GRA)

N77-22412# Harry Diamond Labs., Adelphi, Md.
INTRODUCTION TO CUSTOM COMPLEMENTARY METAL-OXIDE SEMICONDUCTOR (CMOS) LARGE-SCALE INTEGRATED CIRCUITS (LSI'S) FOR DIGITAL LOGIC
Robert V. Garver Sep. 1976 31 p refs
(DA Proj. 1X3-64307-D212)
(AD-A033080; HDL-TM-76-21) Avail: NTIS HC A03/MF A01 CSCL 09/5

This report contains well-known, but seldom assembled, information necessary for understanding and initiating the design of complementary metal-oxide semiconductor (CMOS) large-scale integrated circuit (LSI) digital logic using arrays of gates. A description is given of how CMOS field-effect transistors operate and how logic elements are made using them. The design of logic circuits is given, including brief descriptions of Boolean algebra and Karnaugh maps. Finally, custom LSI's and the CMOS gate array are briefly discussed. Author (GRA)

N77-22413# Raytheon Co., Waltham, Mass. Special Microwave Devices.
MANUFACTURING METHODS AND TECHNOLOGY ENGINEERING HIGH EFFICIENCY, HIGH POWER GALLIUM ARSENIDE READ-TYPE IMPATT DIODES Quarterly Report, 1 Apr. - 30 Jun. 1976
H. R. Chalifour Jul. 1976 88 p
(Contract DAAB07-75-C-0045)
(AD-A033479; Rept-0976-1283) Avail: NTIS HC A05/MF A01 CSCL 09/1

Controlled tests have shown that uniformity of diode parameters is largely due to the degree of uniformity in the starting wafer. The nominal characteristics are influenced by diode assembly processes, however. Diode efficiency is slightly improved by using ribbon in place of mesh on the diode junction metallization. The fourth set of engineering samples have met all of the contract specifications. One X-band failure occurred during the third operating life test. There were no failures at Ku-band. Author (GRA)

N77-22414# RCA Labs., Princeton, N.J.
BASIC ADHESION MECHANISMS IN THICK AND THIN FILMS Quarterly Report, 1 Jul. - 30 Sep. 1976
Thomas T. Hitch and Kenneth R. Bube 31 Oct. 1976 38 p refs
(Contract N00019-76-C-0256)
(AD-A033528; PRRL-76-CR-50) Avail: NTIS HC A03/MF A01 CSCL 09/1

The study concentrated on improving understanding of thick-film conductors of the Au-Pt class. The work is divided into two categories - commercial ink studies and model ink (RCA-formulated material) studies. In the model ink studies section, data are presented on solder wettability for combinations of individually printed frit and metal layers as a function of metal layer alloy composition, frit composition, print thickness, and firing time and temperature. Adhesion data obtained with a tensile mode solder adhesion test are presented for some of these combinations. Extensive adhesion data were taken on six selected commercial ink materials fired onto two alumina substrate types (96 and 99.5 wt pct purities). The data presented represent films prepared by matrices of process variations and stressed with environmental conditions known to degrade Au-Pt materials. GRA

N77-22415# Polytechnic Inst. of New York, Farmingdale. Dept. of Electrical Engineering.
SURFACE RAY METHODS FOR MUTUAL COUPLING IN CONFORMAL ARRAYS ON CYLINDRICAL AND CONICAL SURFACES Final Report, Sep. 1975 - 29 Feb. 1976
Z. W. Chang, L. B. Felsen, and A. Hessel Jul. 1976 131 p
(Contract N00123-76-C-0236)
(AD-A033544; Poly-EE/EP-76-016) Avail: NTIS HC A07/MF A01 CSCL 09/3

This report describes a stage of development of Surface Ray Methods for mutual coupling in conformal arrays of aperture elements on conducting cylindrical surfaces with a subsequent generalization to conical surfaces. Asymptotic techniques are used to develop expressions for the dyadic Green's function for a circumferential and axial magnetic current sources. These expressions are to lowest order in 1/ka and two orders in 1/kD, where ka is the cylinder circumference in free space wavelengths and kD is the length in radians of the geodesic distance from the source to the observation point on the cylinder surface. The region of validity of these expressions does not include the paraxial region. Rigorous transition functions for this region have not yet been derived, but instead, in this report, approximate transition functions have been developed. These transition functions are employed to obtain numerical results for the mutual admittance or the coupling coefficients between 'single mode' circumferential and axial slots on cylinders with ka approx 10 or 20. The numerical results are compared with those obtained via harmonic series and via GTD formulation. (GRA)

N77-22416# Honeywell, Inc., Golden Valley, Minn.
MANUFACTURING METHODS AND TECHNIQUES FOR PIEZOELECTRIC TRANSFORMERS Quarterly Progress Report, 14 Apr. - 14 Jul. 1976
William B. Harrison, L. Hiltner, and W. Kammeyer 5 Nov. 1976 65 p refs
(Contract DAAB07-76-C-0008)
(AD-A032694; Rept-46585; QPR-4) Avail: NTIS HC A04/MF A01 CSCL 09/1

The progress and status of this program to establish a cost-effective production capability for 18mm and 25mm piezoelectric ceramic transformers are described. The construction and test results from engineering samples is reviewed. The life test station and results on the first and second engineering samples is also presented. GRA

N77-22417# Coast Guard, Wildwood, N. J. Electronics Engineering Center.
EVALUATION OF HIGH POWER TUBES FOR LORAN-C USE Interim Report, May 1975 - Sep. 1976
Gary R. Sobotka 11 Nov. 1976 38 p
(AD-A032811; EECEN-WX016-B4; IR-1) Avail: NTIS HC A03/MF A01 CSCL 09/1

Problems in the operation of the EIMAC Y-711 Power Grid Tube when used in the second intermediate power amplifier of the AN/FPN-44/45 Transmitter have been encountered by LORSTAs DANA and EJDE. These problems involved numerous overloads and an inability to obtain rated transmitter output. Tests have been conducted to determine the nature, cause, and possible solution to these problems. The tests involved the operating parameters of the tube and transmitter such as tube dynamic characteristics, drive and pulse shape, biasing conditions, transmitter drive level, and tube high voltage breakdown level. The Y-711 tube exhibits a negative grid current region and will therefore overload the transmitter if overdriven. It is hypothesized that the problem encountered in the field is due to an imperfect drive waveform requiring higher drive levels than normal. Under correct conditions of pulse shape, the tube works satisfactorily. Author (GRA)

N77-22418# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
MANUFACTURING METHODS AND TECHNOLOGY PROGRAM FOR BEAM LEAD SEALED JUNCTION SEMICONDUCTOR DEVICES Quarterly Progress Report, 21 May - 21 Aug. 1976

Dale Buhanan, Frank McMillan, and Joe Wise Aug. 1976 30 p
(Contract DAAB07-75-C-0033)
(AD-A033591; QPR-5) Avail: NTIS HC A03/MF A01 CSCL 09/5

Yields on 5400 and 54LS integrated circuits continue to improve as predicted. The exception is on a few lots where equipment problems or errors resulted in unsatisfactory results. Designs and design changes are reviewed on all of the integrated circuits. Yields on the discrete devices are still discouraging. However, the basic designs are good; only processing variations are of concern. It is believed that yields will improve as additional lots are processed during the confirmatory phase. Author (GRA)

N77-22419# Rockwell International Corp., Richardson, Tex. Hybrid Microelectronics Div.
A PRODUCTION ENGINEERING MEASURE FOR TWO L-BAND SOLID-STATE MICROWAVE FREQUENCY SOURCES Quarterly Report, 30 Apr. - 30 Aug. 1976
Jerome K. McCoy 30 Aug. 1976 53 p refs
(Contract DAAB07-76-C-0026)
(AD-A033346; QR-1) Avail: NTIS HC A04/MF A01 CSCL 09/5

This report describes the specifications and approach, and details the work completed in the design and fabrication of an L Band Radiosonde Modulator/Transmitter and an L Band FM Source. O, RF loss and line definition are a few parameters that will be investigated in the thick film evaluation program. Plans have been formulated for the second set of engineering samples. Author (GRA)

N77-22420# Syracuse Univ., N.Y.
RECTANGULAR FLAT-PACK LIDS UNDER EXTERNAL PRESSURE: IMPROVED FORMULAS FOR SCREENING AND DESIGN Final Technical Report, Jun. 1975 - Jun. 1976
Charles Libove Sep. 1976 74 p refs
(Contract F30602-71-C-0312)
(AD-A032490; RADC-TR-76-291) Avail: NTIS HC A04/MF A01 CSCL 09/5

Earlier work is improved and extended to provide formulas for the maximum tensile stress in the lid-to-wall seal, the maximum lid deflection, and the lid collapsing pressure for a rectangular flat pack under external pressure. It is shown how these formulas can facilitate (a) the proper design of the package so that it will retain its hermeticity and serviceability under a given screening pressure, and (b) the selection of a proper pressure to use in the hermeticity screening of an already designed package. Information is also given in the approximate equivalence of external pressure and centrifuge acceleration in regard to the seal stresses and lid behavior. Finally, experimental data on package hermeticity are presented, which tend to confirm the validity of the main hypotheses of the present work. Author (GRA)

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics*.

N77-22421*# Advanced Technology Labs., Inc., Jericho, N. Y.
A FORTRAN PROGRAM FOR THE DETERMINATION OF NOZZLE CONTOURS FOR ROTATIONAL, NON-HOMENTROPIC GAS MIXTURES
P. Kalben Mar. 1977 27 p ref
(Contract NAS1-9560)
(NASA-CR-145196; ATL-TM-148) Avail: NTIS HC A03/MF A01 CSCL 20D

A program was written which generates a nozzle contour and the complete flow field for two dimensional or axisymetric flows designed to exit parallel to the axis at uniform pressure. The flow is that of a rotational, non-homentropic gas mixture where viscous effects were neglected and the chemistry is assumed frozen. A description of the numerical program developed, is also described. Author

N77-22422*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
AN INVESTIGATION OF ELECTROHYDRODYNAMIC HEAT PIPES Final Report
R. I. Loehrke Mar. 1977 51 p refs
(Grant NGR-06-002-127)
(NASA-CR-151977) Avail: NTIS HC A04/MF A01 CSCL 20D

The principles of electrohydrodynamic heat pip operation are first discussed. Evaporator conductance experiments are then described. A heat pipe was designed in which grooved and ungrooved evaporator surfaces could be interchanged to evaluate the necessity of capillary grooves. Optimum electrode spacing was also studied. Finally, heat convection in evaporating thin films is considered. D.M.L.

N77-22423*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
THERMAL INSULATION PROTECTION MEANS Patent Application
Robert L. Dotts, Robert J. Maraia, James A. Smith, George Strouhal, and Ivan K. Spiker, inventors (to NASA) Filed 15 Apr. 1977 13 p
(NASA-Case-MSC-12737-1; US-Patent-Appl-SN-788045) Avail: NTIS HC A02/MF A01 CSCL 20D

Thermal insulation for portions of a spacecraft which do not exceed 900 F during ascent or reentry into the earth's atmosphere was designed. The thermal insulation is formed of relatively large flexible sheets of needled Nomex felt having a flexible waterproof coating. The thickness of the felt is designed to protect against projected temperatures and is attached to the structure by a resin adhesive. Vent holes in the sheets allow ventilation while maintaining waterproofing. The system is heat treated to provide thermal stability. NASA

N77-22424*# AiResearch Mfg. Co., Torrance, Calif.
JOULE-THOMSON EXPANDER AND HEAT EXCHANGER Final Technical Report
R. H. Norman 17 Nov. 1976 67 p refs
(Contract NAS2-8984)
(NASA-CR-151978) Avail: NTIS HC A04/MF A01 CSCL 20D

The Joule-Thomson Expander and Heat Exchanger Program was initiated to develop an assembly (JTX) which consists of an inlet filter, counterflow heat exchanger, Joule-Thomson expansion device, and a low pressure jacket. The program objective was to develop a JTX which, when coupled to an open cycle supercritical helium refrigerating system (storage vessel), would supply superfluid helium (He II) at 2 K or less for cooling infrared detectors. Author

N77-22425# California Univ., Livermore. Lawrence Livermore Lab.
METHOD OF INDEPENDENT TIMESTEPS IN THE NUMERICAL SOLUTION OF INITIAL VALUE PROBLEMS Ph.D. Thesis
A. P. Porter 21 Jul. 1976 172 p refs
(Contract W-7405-eng-48)
(UCRL-52108) Avail: NTIS HC A08/MF A01

It is shown that it is possible to choose different timesteps natural to different parts of the mesh and to advance each zone in time only as often as is appropriate to that zone's own natural timestep. An investigation of the conditions for well posedness, consistency, and stability in independent timesteps is presented; a new method results. The reasons (well-posedness) for constraining the Cauchy surfaces to be prochronic (as distinct from the method of Grandey), that is, to lie prior to the time of the crisis zone (the zone of least timestep), are indicated. Stability (in the maximum norm) of parabolic equations and (in the L2 norm) of hyperbolic equations is reviewed, without restricting the treatment to linear equations or constant coefficient. ERA

N77-22426# Oak Ridge National Lab., Tenn. Computer Sciences Div.

LINSED: A ONE DIMENSIONAL MULTIREACH SEDIMENT TRANSPORT MODEL
David W. Fields Oct. 1976 89 p refs
(Contract W-7405-eng-26; NRC Proj. 60190501)
(ORNL/CSD-15) Avail: NTIS HC A05/MF A01

A model of sediment transport for a rectangular stream channel system, SEDTRN, was combined with a driver code to allow simulation of sediment transport in a one dimensional multi-reach channel system. The model, LINSED, is dimensioned to accept specification of a branching channel system of up to non-nominally homogeneous segments. Sediment input to each reach from external sources along the reach is allowed. ERA

N77-22427# Argonne National Lab., Ill.
DESIGN GUIDE FOR CALCULATING HYDRODYNAMIC MASS. PART 1: CIRCULAR CYLINDRICAL STRUCTURES
S. S. Chen and H. Chung Jun. 1976 80 p refs
(Contract W-31-109-eng-38)
(ANL-CT-76-45-Pt-1) Avail: NTIS HC A05/MF A01

The effect of fluid on natural frequencies is accounted for using the hydrodynamic mass associated with the structure. The design guide provides formulas, graphs, and computer programs for calculating hydrodynamic masses of circular cylindrical structures. ERA

N77-22428# Massachusetts Inst. of Tech., Oak Ridge, Tenn. School of Chemical Engineering Practice.
GAS-LIQUID MASS TRANSFER IN A THREE-PHASE, TAPERED FLUIDIZED BED
P. D. Terpandjian, J. P. Dacierno, P. Stiros, and J. N. Vora 26 Apr. 1976 29 p refs
(Contract W-7405-eng-26)
(ORNL-MIT-231) Avail: NTIS HC A03/MF A01

The overall gas-liquid mass transfer coefficient, K/sub L/a, has been related to gas flow rate, solid particle size, and amount of solid charge for a cocurrent three-phase, tapered fluidized bed. The three phases consisted of oxygen, distilled water, and glass and coal particles from 0.15 to 0.56 mm OD. K/sub L/a was calculated on the basis of a well-mixed continuously stirred tank reactor model. For a constant water flow rate of approximately 750 ml/min and an oxygen flow rate between 600 to 1050ml/min, the value of K/sub L/a appeared to be a maximum for a coal particle size of 0.3 mm. The value of K/sub L/a was not significantly affected by the amount of coal charged to the column. ERA

N77-22429# Sandia Labs., Albuquerque, N.Mex. Theoretical Div.
SOLUTION OF THE MULTIPOINT DISTRIBUTION FUNCTION EQUATIONS FOR NONISOTROPIC FREE TURBULENCE
R. L. Fox Aug. 1976 18 p refs
(Contract E(29-1)-789)
(SAND-76-0187) Avail: NTIS HC A02/MF A01

The turbulent multipoint hierarchy is approximated to obtain a set of relations for free shear flow analogous to previously solved equations for homogeneous isotropic flow. The solution to the multipoint equations is derived. The multipoint functions are integrated to obtain the energy spectrum. The predicted spectra are compared with experimental measurements. ERA

N77-22430# Argonne National Lab., Ill.
DYNAMICS OF TWO COAXIAL CYLINDRICAL SHELLS CONTAINING VISCOUS FLUID
Tsyh-Tyan Yeh and S. S. Chen Sep. 1976 62 p refs
(Contract W-31-109-eng-38)
(ANL-CT-76-48) Avail: NTIS HC A04/MF A01

The system component is modeled as two coaxial shells separated by a viscous fluid. In the analysis, Flugge's shell equations of motion and linearized Navier-Stokes equation for viscous fluid are employed. First, a traveling-wave type solution is taken for shells and fluid. Then, from the interface conditions between the shells and fluid, the solution for the fluid medium is expressed in terms of shell displacements. Finally, using the shell equations of motion gives the frequency equation, from which the natural frequency, mode shape, and modal damping ratio of coupled modes can be calculated. ERA

N77-22431# PFR Engineering Systems, Inc., Marina Del Rey, Calif.
HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICS OF DRY TOWER EXTENDED SURFACES. PART 1: HEAT TRANSFER AND PRESSURE DROP DATA
1 Mar. 1976 212 p refs
(Contract E(45-1)-1830)
(BNWL-PFR-7-100-Pt-1) Avail: NTIS HC A10/MF A01

A compilation is presented of heat transfer and pressure drop data which were collected from literature reports on extended surface heat exchangers. The type of extended surfaces considered are tubular finned tubes as distinct from compact heat exchangers. These surfaces have a base tube to which additional surface was added, by mechanical means. This additional surface is in the form of fins attached to the outside surface of the tube. These tubes are normally employed for heat transfer between a liquid and a gas. The liquid flows inside the tubes, and the gas, normally air, flows outside the tubes. The fins are oriented so that their surface is transverse to the axis of the tubes. The gas flows across the tubes in a direction parallel to the fin surface. ERA

N77-22432# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
SIMILARITY SOLUTIONS FOR MIXED CONVECTION FROM HORIZONTAL IMPERMEABLE SURFACES IN SATURATED POROUS MEDIA
Ping Cheng Aug. 1976 24 p refs
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261561/5; HGP-TR-16; NSF/RA-760375) Avail: NTIS HC A02/MF A01 CSCL 08I

Boundary layer analysis is performed for mixed convection about a horizontal flat plate in a saturated porous medium with aiding external flows, where the governing parameter is found to be Ra /(Re Pr) to the 3/2 power. Similarity solutions are obtained for horizontal flat plates at zero angle of attack with constant heat flux, and stagnation point flows about horizontal flat plates with wall temperature varying as (T sub W) alpha (x squared). Temperature and velocity profiles for these two cases at selected values of Ra /(Re Pr) to the 3/2 power are presented. GRA

N77-22433# Naples Univ. (Italy).
APPLICATION OF FUNCTIONAL ANALYSIS IN FLUID-MECHANICS Final Report, 1 Jul. 1975 - 1 Jul. 1976
L. G. Napolitano Jul. 1976 47 p refs
(Grant AF-AFOSR-2889-76)
(AD-A032922; IA-235; AFOSR-76-1185TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The report gives the appropriate references of papers originated under the subject Grant. In addition, it presents in detail the theory underlying an inverse functional approach for the derivation of variational formulations (classical, dual, and hybrid) of continuum mechanics linear problems and the theory of a new class of spline functions which are herein called closed spline functions. GRA

N77-22434# Naval Ship Research and Development Center, Bethesda, Md.
SIMILARITY-LAW ENTRAINMENT METHOD FOR TWO-DIMENSIONAL TURBULENT BOUNDARY LAYERS IN PRESSURE GRADIENTS
Paul S. Granville Dec. 1975 50 p refs
(ZR0230101)
(AD-A031733; DTNSRDC-4657) Avail: NTIS HC A03/MF A01 CSCL 20/4

Analytical relations have been derived for calculating a developing two-dimensional turbulent boundary layer in a pressure gradient from two simultaneous differential equations: momentum and shape parameter. An entrainment method is used to obtain the shape parameter equation. Both equations incorporate the velocity similarity laws that provide a two-parameter velocity profile general enough to include any range of Reynolds numbers. The entrainment factor is based on the characteristics of equilibrium pressure gradients in a way which can accommodate the usual pressure gradients found in engineering applications. The method includes a newly formed wake modification for the similarity laws as well as added effects due to low Reynolds

numbers. The variation of momentum loss boundary-layer thickness, local skin friction, and local velocity profile may be calculated for the boundary layers on hydrofoils and two-dimensional appendages. The various formulations are shown to correlate well with available experimental data. Author (GRA)

N77-22435# Naval Ship Research and Development Center, Bethesda, Md. Ship Performance Dept.
ELEMENTS OF THE DRAG OF UNDERWATER BODIES Final Report
Paul S. Granville Jun. 1976 35 p refs
(AD-A031995; SPD-672-01) Avail: NTIS HC A03/MF A01 CSCL 20/4

Elementary aspects of the drag of underwater bodies are reviewed. Shape and boundary-layer concepts are included. Optimization of shape is considered and drag reduction is discussed. Author (GRA)

N77-22436# Stanford Univ., Calif. Thermosciences Div.
MOMENTUM AND ENERGY TRANSPORT IN THE ACCELERATED FULLY ROUGH TURBULENT BOUNDARY LAYER Interim Report
Hugh W. Coleman, Robert J. Moffat, and William M. Kays Mar. 1976 166 p refs
(Contract N00014-76-C-0532)
(AD-A031495; HMT-24) Avail: NTIS HC A08/MF A01 CSCL 20/4

The behavior of the fully rough turbulent boundary layer subjected to favorable pressure gradients was investigated experimentally using a porous test surface composed of densely packed spheres of uniform size. Measurements of profiles of mean velocity, mean temperature and the components of the Reynolds stress tensor are reported for both unblown and blown layers. Stanton numbers were determined from energy balances on the test surface and skin friction coefficients from measurements of the Reynolds shear stress and mean velocity. GRA

N77-22437# Dayton Univ. Research Inst., Ohio.
WATER DROP BREAKUP/IMPACT DAMAGE THRESHOLDS Final Report, Jul. 1975 - Jul. 1976
John P. Barber Jul. 1976 64 p refs
(Contract F33615-76-C-5038; AF Proj. 627A)
(AD-A032429; UDRI-TR-76-55; AFML-TR-76-126) Avail: NTIS HC A04/MF A01 CSCL 16/3

An investigation of the breakup criteria for water droplets traversing reentry vehicle bow shocks was conducted. Hemispherical, ATJS graphite tipped, 20 mm projectiles were launched at reentry velocities (2.5 km/s to 4.5 km/s) into a single stream of well separated, cloud sized water droplets (20- to 100-micrometer diameter). The projectile nosetip was observed about 1 microsec after impact with the droplets. If the droplets survived transit through the shock layer, impact debris plumes were observed. If the droplets broke up in the shock layer, impact debris was not observed. The bow shock layer aerodynamic conditions were systematically varied to investigate the transition (breakup criteria) over a range of Weber numbers (We) from about 20,000 to 160,000. The results showed good agreement with previous indirect measurements of breakup. Author (GRA)

N77-22438# Houston Univ., Tex. Dept. of Chemical Engineering.
FLOW REGIME TRANSITIONS FOR VERTICAL UPWARD GAS LIQUID FLOW: A PRELIMINARY APPROACH THROUGH PHYSICAL MODELLING Progress Report
A. E. Dukler and Y. Taitel Jan. 1977 55 p refs
(Contract E(10-1)-1571)
(PB-263052/3; NUREG-0162; PR-1) Avail: NTIS HC A04/MF A01 CSCL 20D

Transitions for vertical upflow of gas-liquid systems are modeled. A method for predicting transitions is soundly based on the results of the work. With the initial conceptual studies of the transient flow regime behavior complete in this report, it will be possible to write computer programs to explore the ideas in the second report of the study. GRA

N77-22439# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Mechanical Engineering.
NEAR-WALL SIMILARITY IN THREE-DIMENSIONAL TURBULENT FLOWS - EXPERIMENTAL SYSTEM Interim Report
F. J. Pierce, M. H. Tennant, and J. A. Rule Aug. 1976 34 p refs
(Grant NSF ENG-73-03737-A01)
(PB-261112/7; VPI-E-76-16) Avail: NTIS HC A03/MF A01 CSCL 14B

Low speed wind tunnel and associated instrumentation for use in near-wall similarity study in three-dimensional flows are reported. Tunnel design, alternate instrumentation for a direct force sensing wall shear meter, design of an omnidirectional shear meter, tunnel performance, and calibration in the two-dimensional mode of operations are discussed. GRA

N77-22440# West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics.
PULSATING FLOW OF AN INCOMPRESSIBLE FLUID THROUGH A SHARP-EDGED ORIFICE METER, PHASE 1 Final Report
M. T. Pellegrin and R. A. Bajura Jun. 1976 355 p refs
(Grant NSF ENG-74-10399)
(PB-261182/0; NSF/ENG-74-10399-A) Avail: NTIS HC A16/MF A01 CSCL 14B

The performance of standard ASME orifice meters under pulsating flow conditions was studied. Three orifice beta ratios were tested (0.35, 0.50 and 0.70) for three pressure tap configurations. Velocity profiles and differential pressure measurements were obtained for flows with pulsation frequencies in the range of 2 to 8 hz with flow Reynolds numbers in the range of 10 to 20,000, based upon the 4 inch pipe diameter. An analytical model for flow metering errors in the presence of pulsations is developed and analyzed on a digital computer. GRA

N77-22441# West Virginia Univ., Morgantown. Dept. of Mechanical Engineering and Mechanics.
PULSATING FLOW THROUGH A SLIT ORIFICE PHASE 1 Final Report
L. R. Farr and R. A. Bajura Jun. 1976 129 p refs
(Grant NSF ENG-74-10399)
(PB-261147/3; NSF/ENG-74-10399-b) Avail: NTIS HC A07/MF A01 CSCL 20D

A water table facility with a rectangular channel was used to conduct visual and hot-film anemometry studies of steady and pulsating flow through a slit orifice. The characteristics of the flow field were studied for various beta ratios, pulsation frequencies, and pulsation amplitudes for a range of Reynolds numbers from 3000-9000. Under pulsating flow conditions, the characteristics of the flow field were found to be a complex function of beta ratio, pulsation frequency, pulsation amplitude, Reynolds number, and system response. The characteristics of the flow field were classified. GRA

N77-22442# Advisory Group for Aerospace Research and Development, Paris (France).
COMPUTATIONAL FLUID DYNAMICS
Apr. 1977 170 p refs
(AGARD-LS-86) Avail: NTIS HC A08/MF A01

Fluid dynamic research is reviewed, including finite element methods for fluid flow calculations and for solving partial differential equations. Numerical treatment of turbulence modelling and Navier-Stokes equations are also considered, along with relaxation methods for time dependent conservation equations. For individual titles, see N77-22443 through N77-22448.

N77-22443# Maryland Univ. Baltimore County, Baltimore. Dept. of Mathematics.
THE FOUNDATION AND DEVELOPMENT OF THE FINITE ELEMENT METHOD TO SOLVE PARTIAL DIFFERENTIAL EQUATIONS OF FLUID MECHANICS
A. K. Aziz and S. Leventhal (Naval Surface Weapons Center, White Oak, Md.) *In* AGARD Computational Fluid Dyn. Apr. 1977 25 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

The mathematical theory is given beginning with the variational formulation of a problem. The three basic steps in the finite element method are discussed: (1) the subdivision of the domain; (2) the definition of the elements to approximate the unknown functions; and, (3) the forming of the algebraic

system for the unknown coefficients. Application of the finite element method to two problems in fluid mechanics is also given. The first of these problems is boundary layer flow, and the other is transonic flow. Author

N77-22444# Naval Ship Research and Development Center, Bethesda, Md. Numerical Mechanics Div.
RECENT ADVANCES IN THE NUMERICAL TREATMENT OF THE NAVIER-STOKES EQUATIONS
Hans J. Lugt *In* AGARD Computational Fluid Dyn. Apr. 1977 17 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

Some recent developments in finite difference methods for the solution of the Navier-Stokes equations are discussed. Emphasis is placed on the computational difficulties encountered at and near bounding surfaces and in situations of high body acceleration. Physical and numerical aspects of initial and boundary conditions are considered, along with their influence on the solutions. Slip and nonslip boundary conditions, their occurrence in reality, their significance in flow modeling, and their effect on the generation and decay of vortices and vorticity are discussed. Recent studies of higher-order approximations and the treatment of boundaries of arbitrary shape by body-fitted coordinate systems are pointed out. The interpretation of time dependent viscous flows in various reference frames is difficult and necessitates the careful analysis of velocity and vorticity fields. This is demonstrated for flow separation, vortices, and rotating bodies. Author

N77-22445*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL TURBULENCE MODELING
Morris W. Rubesin *In* AGARD Computational Fluid Dyn. Apr. 1977 37 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

The underlying bases and developments in two techniques of detailed turbulence modeling are described where the flow is treated in the Eulerian sense, and one technique where the Lagrangian motions of vortices are followed. First, a technique is described for solving the single-point statistically averaged conservation equations. The Reynolds stresses that appear in these equations are evaluated by solving supplemental differential equations which contain terms that are modeled. A sequence of increasingly complex, but also increasingly general, modeling equations is described and computations based on these equations are compared with experimental data. The hierarchy of models described terminates with equations for the individual components of the Reynolds stress tensor. The second Eulerian technique approach to turbulence modeling is the direct numerical simulation of turbulent fields. In this approach, all three dimensional eddies between a predetermined range of sizes are computed in time within a specified volume of flow. Present day computers require a tradeoff between the size of the volume that can be considered and the degree of resolution of the turbulent eddies. Techniques of modeling the smallest eddies are described that permit enlarging the volume, or Reynolds number, that can be considered. Author

N77-22446# Von Karman Inst. for Fluid Dynamics, Rhode-Saint-Genese (Belgium).
RELAXATION METHODS FOR TIME DEPENDENT CONSERVATION EQUATIONS IN FLUID MECHANICS
H. J. Wirz *In* AGARD Computational Fluid Dyn. Apr. 1977 49 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

Iterative methods in general are characterized. The successive application of a method led to a state, which is invariant with respect to further iterations (convergence): this invariant state (which will be identified with the steady state for our purpose) was independent of the choice of the initial guess (unicity). Since only a limited amount of iteration steps were carried out, the question of accuracy of the solution (error estimation) was considered. This problem was independent of the reliability of the discrete model being used to represent the continuous conservation equation. It is desirable and crucial for the success of the application of an iterative method, that the process converges as fast as possible to the invariant state (rate of convergence) using a minimum amount of operations per iteration step. Author

N77-22447# Bristol Univ. (England). Dept. of Engineering Mathematics.
FLOW REPRESENTATION, INCLUDING SEPARATED REGIONS, USING DISCRETE VORTICES
R. R. Clements *In* AGARD Computational Fluid Dyn. Apr. 1977 20 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

The kinematic properties of fluid motion were utilized to determine the motion of the line vortices and the evolution of the flow field is inferred from this motion. Two dimensional, axisymmetric and fully three dimensional flows were treated by such methods, the complexity and duration of the computations increasing. One of the interesting aspects of the method is the various means which its users have developed for the incorporation of solid boundaries into the flow field. Two dimensional complex potential flow theory and the surface source/sink method have both been used in a variety of contexts. Many computations have involved imbedded solid objects of a nature such that the vorticity creating boundary layers separate from the object to create separated shear layers in the flow, and it is to the treatment of these separated layers that the method is applied. The various models of the connection between the shear layers and the discrete vortices form another most interesting aspect of the subject. Author

N77-22448# Paris V Univ. (France).
SOME FINITE ELEMENT METHODS IN FLUID FLOW
R. Tema *In* AGARD Computational Fluid Dyn. Apr. 1977 15 p refs (For primary document see N77-22442 13-34)
Avail: NTIS HC A08/MF A01

Some finite element methods are described which were recently introduced for the computation of viscous and inviscid incompressible flows. Some finite element methods of the displacement type are discussed which apply to viscous flows, with emphasize on a linear nonconforming finite element. The principle of the weak (or variational) formulation for the Stokes and Navier Stokes equations, and their Galerkin-finite element discretization are considered. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources*. For related information see also *06 Aircraft Instrumentation*, and *19 Spacecraft Instrumentation*.

N77-22449* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AMPLIFYING RIBBON EXTENSOMETER Patent
Vernon L. Alley, Jr. and Austin D. McHatton, inventors (to NASA) Issued 19 Apr. 1977 10 p Filed 14 Nov. 1975 Supersedes N76-13460 (14 - 04, p 0454)
(NASA-Case-LAR-11825-1; US-Patent-4,018,085; US-Patent-Appl-SN-632112; US-Patent-Class-73-88R) Avail: US Patent Office CSCL 14B

A self-contained, nonelectrical strain gage capable of amplifying strain inputs and preserving the maximum strain measurement for later observance is presented. Official Gazette of the U.S. Patent Office

N77-22450* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVICE FOR TENSIONING TEST SPECIMENS WITHIN AN HERMETICALLY SEALED CHAMBER Patent
Page K. Evans and Dan L. Shady, inventors (to NASA) (Sperry Rand Corp., Huntsville, Ala.) Issued 19 Apr. 1977 7 p Filed 13 Feb. 1976 Supersedes N76-18413 (14 - 09, p 1120)
(NASA-Case-MFS-23281-1; US-Patent-4,018,080; US-Patent-Appl-SN-657995; US-Patent-Class-73-15.6;

US-Patent-Class-73-95) Avail: US Patent Office CSCL 14B

The device is characterized by a support column adapted to be received within an insulated, hermetically sealable chamber. A plurality of anchor pins are mounted on the column for releasibly connecting thereto a plurality of test specimens. A plurality of axially displaceable pull rods are received by the column in coaxial alignment with the anchor pins. One end of each pull rod is provided with a coupling for connecting the pull rod to a test specimen. The opposite end of the pull rod is entended through a cover plate and adapted to be connected with a remotely related linear actuator through a connecting link including a load cell for measuring stress as the pull rod is placed in tension by the actuator. Official Gazette of the U.S. Patent Office.

N77-22451*# Santa Barbara Research Center, Goleta, Calif.
ADVANCED ATMOSPHERIC SOUNDER AND IMAGING RADIOMETER (AASIR) Final Report
10 Mar. 1977 219 p
(Contract NAS5-20963)
(NASA-CR-152495) Avail: NTIS HC A10/MF A01 CSCL 14B

Design information for the Advanced Atmospheric Sounder and Imaging Radiometer is reported, which was developed to determine the configuration of a sensor for IR and visible imaging. The areas of technology reported include: systems design, optics, mechanics, electronics, detectors, radiative cooler, and radiometric calibration. Author

N77-22452*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NONDESTRUCTIVE METHOD FOR INSTRUMENTING HELICOPTER ROTOR BLADES Patent Application
Walt C. Long and Milton C. Williams, inventors (to NASA) Filed 19 Apr. 1977 17 p
(NASA-Case-LAR-11201-1; US-Patent-Appl-SN788705) Avail: NTIS HC A02/MF A01 CSCL 14B

An invention which relates generally to methods of airfoil pressure instrumentation, and more particularly to a nondestructive method of applying and removing external pressure instrumentation to helicopter rotor blades without significantly affecting the aerodynamics of the blade and without damaging or altering the blade structure, is described. Author

N77-22453*# California Univ., Berkeley. Lawrence Berkeley Lab.
EVALUATION OF THE AMPEREX 56 TVP PHOTOMULTIPLIER
C. C. Lo and B. Leskovar 7 Jul. 1976 25 p refs Sponsored in part by NASA
(Contract W-7405-ENG-48)
(NASA-CR-152835; LBL-5328) Avail: NTIS HC A02/MF A01 CSCL 33A

Characteristics were measured for the Amperex 56 TVP 42 mm-diameter photomultiplier. Some typical photomultiplier characteristics-such as gain, dark current, transit and rise times-are compared with data provided. Photomultiplier characteristics generally not available such as the single photoelectron time spread, the relative collection efficiency, the relative anode pulse amplitude as a function of the voltage between the photocathode and focusing electrode, and the position of the photocathode sensing area were measured and are discussed for two 56 TVP's. The single photoelectron time spread, the relative collection efficiency, and the transit time difference as a function of the voltage between photocathode and focusing electrode were also measured and are discussed, particularly with respect to the optimization of photomultiplier operating conditions for timing applications. ERA

N77-22454# California Univ., Berkeley. Lawrence Berkeley Lab.
PERFORMANCE STUDIES OF PROTOTYPE MICROCHANNEL PLATE PHOTOMULTIPLIERS
C. C. Lo, Pierre Lecomte, and Branko Leskovar Oct. 1976 12 p refs Presented at the Nuclear Science, Scintillation and Semiconductor Counter Symp., New Orleans, La., 20 Oct. 1976
(Contract W-7405-ENG-48)
(LBL-5520; Conf-761006-18) Avail: NTIS HC A02/MF A01

The characteristics of prototype photomultipliers having high gain microchannel plates for electron multiplication were investigated. Measurements are given of the dark current, quantum efficiency, anode pulse amplitude, electron transit time, single photoelectron time spread, and pulse height resolution of LEP HR 350 and HR 400 photomultipliers. The gain, the collection efficiency, and the single electron pulse amplitude were measured as functions of the ambient axial and transverse magnetic fields. Measurement techniques and descriptions of the measuring systems are given in detail. ERA

N77-22455# Comstock and Wescott, Inc., Cambridge, Mass.
NORMAL-INCIDENCE EXTREME ULTRAVIOLET GRATING SPECTROMETER Final Report, 1 Sep. 1973 - 30 Jun. 1976
Joseph P. Padur Hanscom AFB, Mass. AFGL 31 Jul. 1976 32 p ref
(Contract F19628-74-C-0002)
(AD-A032310; AFGL-TR-76-0171) Avail: NTIS HC A03/MF A01 CSCL 14/2

This report describes the design, development, and fabrication of a normal-incidence ultraviolet grating spectrometer for sounding rockets and the field services supporting its launch. Author (GRA)

N77-22456# Research Triangle Inst., Research Triangle Park, N.C.
GAS DETECTION INSTRUMENTATION USING METAL OXIDE SENSOR TECHNOLOGY Technical Report, 29 May 1974 - 15 Oct. 1975
P. A. Lawless, J. W. Harrison, A. D. Brooks, and P. K. Ajmera Jan. 1976 142 p refs
(Contract DI-BM-HO 346015)
(PB-262479/9; BM-OFR-12-77) Avail: NTIS HC A07/MF A01 CSCL 07D

The objective of the research was to develop a portable instrument for the detection of carbon monoxide (CO) in a mine environment. The desired characteristics were sensitivity and specificity for CO with a stable calibration. The sensor of the instrument was to be of metal oxide composition, requiring low power for compatibility with the types of batteries presently used in personal equipment in mines. The solid state design was also desired for ruggedness and small size. A key design feature of the instrument was to be provided by adherence to the intrinsic safety design requirements for electrical equipments operated in potentially explosive mine atmospheres. GRA

N77-22457*# National Bureau of Standards, Washington, D.C. Engineering Mechanics Section.
OPERATION MANUAL FOR 30,000 LBF CONSTANTLOAD TESTING MACHINE
Donald E. Marlowe and W. H. Appleton Oct. 1976 31 p Sponsored by NASA
(NASA-CR-152815; PB-261497/2; NBSIR-76-1074) Avail: NTIS HC A31/MF A01 CSCL 14B

A 30,000 lbf (133 kN) constant-load testing machine has been designed, and ten of these machines have been delivered to the NASA Langley Research Center. Each machine is equipped with a self-contained, closed loop load controller which is maintained at a constant temperature, independent of the external ambient conditions. GRA

N77-22458# Environmental Monitoring and Support Lab., Cincinnati, Ohio. Instrumentation Development Branch.
A SURVEY OF COMMERCIALLY AVAILABLE AUTOMATIC WASTEWATER SAMPLERS
Sep. 1976 42 p refs
(PB-260908/9; EPA-600/4-76-051) Avail: NTIS HC A03/MF A01 CSCL 14B

Characteristics for waste water samplers are tabularized. Additional comments including short descriptions of each manufacturers' equipment are given. Manufacturers' names and addresses are included. A literature review of the more recent reports on automatic waste water samplers is also included. GRA

N77-22459# Environmental Protection Agency, Cincinnati, Ohio.
EFFLUENT MONITORING PROCEDURES: NUTRIENTS. STUDENT REFERENCE MANUAL Final Report

Audrey Donahue Kroner Jun. 1976 314 p
(PB-261290/1; EPA-430/1-76-006) Avail: NTIS HC A14/MF A01 CSCL 14B

The procedures are for phosphorus; chemical oxygen demand; Kjeldahl nitrogen; ammonia, nitrate and nitrite as nitrogen; oil and grease. Also included are procedures for related basic skills: using a spectrophotometer and preparing calibration graphs.
GRA

N77-22460# Singer Co., Little Falls, N.J. Kearfott Div.
LIQUID BEARING GYRO INVESTIGATION Final Technical Report, 17 Apr. 1974 - 30 Jun. 1975
John Evans and Michael Tarasevich Oct. 1976 75 p refs
(Contract F33615-74-C-1136)
(AD-A032214; AFAL-TR-75-203) Avail: NTIS HC A04/MF A01 CSCL 17/7

The objective of this program was to fabricate and test two liquid hydrodynamic bearings to be subsequently incorporated into a liquid bearing gyro. The liquid bearing design consists of a spiral grooved journal bearing with two 'in-pumping' thrust plates. The low viscosity hydrocarbon bearing fluid is captured in the bearing gap by preloaded mercury ring seals at the ends of the journal shafts. The seal capability has been shown to be greater than one atmosphere under static conditions and greater than two atmospheres under dynamic, running conditions. Instrumented tests show the inherently, noise free operation of the liquid bearing.
GRA

N77-22461# Colorado State Univ., Fort Collins. Dept. of Chemistry.
DIGITAL SIMULATION OF DIFFERENTIAL PULSE POLAROGRAPHY WITH INCREMENTAL TIME CHANGE Interim Report
James W. Dillard, John A. Turner, and R. A. Osteryoung Nov. 1976 33 p refs
(Contract N00014-77-C-0004)
(AD-A032723; TR-1) Avail: NTIS HC A03/MF A01 CSCL 07/4

Explicit finite difference simulations of TAST, normal pulse and differential pulse polarography for the reversible case have been developed for conserving computer time. The method involves changing the time increment during the simulation. The results are shown to conform to accepted theory and include sphericity and the DME compression of the diffusion layer due to the drop expansion in area. The DC faradaic distortion of differential pulse is also studied. The simulation gives a factor of five savings in computer time over simulators of the standard type.
Author (GRA)

N77-22462# Honeywell Radiation Center, Lexington, Mass.
10.6-MICRON (Hg,Cd) Te PHOTODIODE MODULE Final Report, 15 Aug. 1974 - 15 Dec. 1975
Toivo Koehler Ft. Monmouth, New Jersey ECOM Oct. 1976 55 p refs
(Contract DAAB07-71-C-0236; DA Proj. 1S7-62703-DH-93)
(AD-A032851; ECOM-71-0236-F) Avail: NTIS HC A04/MF A01 CSCL 17/5

This report describes the development of a 10.6-micrometers (Hg,Cd)Te thermoelectrically cooled photodiode module operating at 174 K. The objective of the program was the demonstration of 170 K operation with quantum efficiency of 20 percent, bandwidth of 50 MHz, and a 1 mA reverse saturation current in a .0005 sq.cm. area device. Several approaches were assessed in order to achieve a heavily doped junction that would minimize diffusion current at 170 K. Two 10.6-micrometers (Hg,Cd)Te Photodiode Modules, each consisting of a n-on-p diffused (Hg,Cd)Te diode with an active area of .0002 sq.cm. mounted on a 6-stage thermoelectric cooler, were delivered. The better device had a minimum detectable power of 7.7 x 10 to the -19th power W/Hz, 23 MHz bandwidth, and 8.8 mA saturation current at 174 K. The power consumption for the module was less than 20 watts.
Author (GRA)

N77-22463# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
DESIGN AND EVALUATION OF A BALLOON-BORNE ELECTRIC FIELD SENSOR M.S. Thesis
Hugh Joseph Christian, Jr. 18 Oct. 1926 84 p refs
(Contract N00014-75-C-0139)
(AD-A032450; TR-071-761) Avail: NTIS HC A05/MF A01 CSCL 04/1

A new instrument is described for the measurement of electric fields. This application uses a spherical superpressure balloon with an exterior conductive coating and the instrument package located inside the balloon as the lifting device, the sensor, and the instrument shield. This unique design offers superior performance and opportunities here-to-fore inaccessible.
Author (GRA)

36 LASERS AND MASERS

Includes parametric amplifiers.

N77-22464*# RCA Advanced Technology Labs., Camden' N.J.
DIODE PUMPED Nd:YAG LASER DEVELOPMENT Final Report
C. W. Reno and D. G. Herzog May 1976 99 p refs
(Contract NAS5-23281)
(NASA-CR-152492; ATL-CR-76-02) Avail: NTIS HC A05/MF A01 CSCL 20E

A low power Nd:YAG laser was constructed which employs GaAs injection lasers as a pump source. Power outputs of 125 mW TEM CW with the rod at 250 K and the pump at 180 K were achieved for 45 W input power to the pump source. Operation of the laser, with array and laser at a common heat sink temperature of 250 K, was inhibited by difficulties in constructing long-life GaAs LOC laser arrays. Tests verified pumping with output power of 20 to 30 mW with rod and pump at 250 K. Although life tests with single LOC GaAs diodes were somewhat encouraging (with single diodes operating as long as 9000 hours without degradation), failures of single diodes in arrays continue to occur, and 50 percent power is lost in a few hundred hours at 1 percent duty factor. Because of the large recent advances in the state of the art of CW room temperature AlGaAs diodes, their demonstrated lifetimes of greater than 5,000 hours, and their inherent advantages for this task, it is recommended that these sources be used for further CW YAG injection laser pumping work.
Author

N77-22465*# Raytheon Co., Sudbury, Mass. Dept. of Electro-Optics.
STUDY FOR HARDWARE APPLICATION OF AIRBORNE LASER DOPPLER SYSTEM FOR SEVERE STORMS MEASUREMENT Final Report
16 Feb. 1977 86 p refs
(Contract NAS8-31721)
(NASA-CR-150244; ER77-4036) Avail: NTIS HC A05/MF A01 CSCL 20E

Specifications are discussed for the overall system configuration, the processor, the scanner, the CO2 laser, and data analysis methods required to measure velocity flow fields associated with severe storms. Modifications to the clear air turbulence (CAT) system and its capability for two dimensional measuring are examined.
A.R.H.

N77-22466*# Westinghouse Research Labs., Pittsburgh, Pa.
DEVELOPMENT OF FAR INFRARED ATTENUATION TO MEASURE ELECTRON DENSITIES IN CW PIN DISCHARGE LASERS Final Report
R. V. Babcock 1977 46 p refs
(Contract NAS3-19702)
(NASA-CR-135154) Avail: NTIS HC A03/MF A01 CSCL 20E

A two beam attenuation technique was devised to measure electron densities 10 to the 9th power to 10 to the 11th power cm/3 resolved to 1 cm, in a near atmospheric COFFEE laser discharge, using 496 micrometer and 1,220 micrometer radiations from CH3F, optically pumped by a CO2 laser. A far infrared generator was developed which was suitable except for a periodic intensity variation in FIR output deriving from frequency variation of the pump radiation.
Author

N77-22467*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SCANNING LASER RANGEFINDER FOR A ROBOTIC VEHICLE
R. A. Lewis and A. R. Johnston 15 Feb. 1977 84 p refs
(Contract NAS7-100)
(NASA-CR-152674; JPL-TM-33-809) Avail: NTIS HC A05/MF A01 CSCL 20E

A scanning Laser Rangefinder (LRF) which operates in conjunction with a minicomputer as part of a robotic vehicle is described. The description, in sufficient detail for replication, modification, and maintenance, includes both hardware and software. Also included is a discussion of functional requirements relative to a detailing of the instrument and its performance, a summary of the robot system in which the LRF functions, the software organization, interfaces and description, and the applications to which the LRF has been put. Author

N77-22468*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPOSED COMPUTER MODEL FOR ELECTRIC DISCHARGE ATOMIC VAPOR LASERS
Kenneth G. Harstad 15 Mar. 1977 90 p refs
(Contract NAS7-100)
(NASA-CR-152681; JPL-Publ-77-11) Avail: NTIS HC A05/MF A01 CSCL 20E

A detailed computer model for the rate kinetics of an atomic vapor laser excited by electrical discharge is proposed. The model equations are defined and the computer program structure is discussed. Author

N77-22469# Princeton Univ., N.J. Plasma Physics Lab.
OPTIMIZATION OF FUSION-DRIVEN FISSIONING SYSTEMS
R. G. Mills and D. L. Chapin Oct. 1976 10 p refs Presented at the Joint US-USSR Symp. on Fusion-Fission Hybrid Reactors, Livermore, Calif., 13 Jul. 1976
(Contract E(11-1)-3073)
(PPPL-1285; Conf-760733-5) Avail: NTIS HC A02/MF A01

Potential advantages of hybrid or fusion/fission systems can be exploited in different ways. With selection of the U-238-Pu-239 fuel cycle, it is show that the system has greatest value as a power producer. Numerical examples of relative revenue from power production vs. Pu-239 production are discussed, and possible plant characteristics described. The analysis tends to show that the hybrid may be more economically attractive than pure fusion systems. ERA

N77-22470# California Univ., Livermore. Lawrence Livermore Lab.
ULTRAFAST X-RAY DIAGNOSTICS FOR LASER FUSION EXPERIMENTS
L. W. Coleman 16 Aug. 1976 12 p refs Presented at 20th Ann. SPIE Tech. Symp., San Diego, Calif., 23 Aug. 1976
(Contract W-7405-eng-48)
(UCRL-78096; Conf-760832-8) Avail: NTIS HC A02/MF A01

Temporal histories of spectrally resolved X-ray emission in the 1 to 10 keV range were obtained. These data served to further define the X-ray streak camera as a quantative diagnostic tool and provided data relating to the absorption and compression phases of laser heating. The X-ray streak camera was used in conjunction with a specially designed pinhole imaging system to temporally record images of laser compressed targets with a spatial resolution of approximately 6 micons. Implosion characteristics are presented for experiments with glass microshell targets. The concept, development, and testing of an ultrafast framing camera for full two-dimensional time resolved imaging is discussed. A prototype camera, based on the image dissection-restoration concept, has achieved an approximately 200 psec frame period with a resolution of 50 microns. ERA

N77-22471# California Univ., Livermore. Lawrence Livermore Lab.
PRELIMINARY STUDY OF THE RECYCLING OF SPENT GASES FROM THE IODINE LASER
R. K. Pearson, ed. 10 Sep. 1976 27 p refs
(Contract W-7405-eng-48)
(UCID-17237) Avail: NTIS HC A03/MF A01

A process is proposed for recycling the spent gases from the iodine laser. Using a simplified form of this process, a preliminary estimate of the energy cost to recycle the perfluoroisopropyliodide-argon gas mixture used as the laser medium in the iodine laser was made. If r is defined as the ratio of the recycling energy to the output energy of the laser, a figure of 70 is arrived at for the most optimistic conditions and 160 for the most probable conditions. A major portion of the energy necessary for recycling is consumed in the synthesis of the perfluoroidide compound. An estimate of the cost to replace the lost perfluoroidide, if purchased, is from $2.4 to 10 million per year, based on a continuous operation at the 100-kJ laser power level. ERA

N77-22472# Los Alamos Scientific Lab., N. Mex.
GAIN UNIFORMITY IN LARGE-APERTURE ELECTRON-BEAM-STABILIZED CO2 AMPLIFIERS
W. T. Leland and M. J. Kircher Aug. 1976 9 p refs
(Contract W-7405-ENG-36)
(LA-6493-MS) Avail: NTIS HC A02/MF A01

A numerical approach was developed to predict gain distribution in large aperture electron beam stabilized CO2 laser amplifiers. An analysis was made for a unit 35 x 35 cm in area and 2 m long. Results were compared with experimental measurements. ERA

N77-22473# Kigre, Inc., Toledo, Ohio.
SENSITIZATION OF Nd-3(+) LASER GLASS AND FARADAY ROTATOR GLASSES Bimonthly Progress Report
J. D. Myers 3 Aug. 1976 5 p refs
(Contract E(11-1)-4028)
(COO-4028-1; BMPR-1) Avail: NTIS HC A02/MF A01

Seven different fluorophosphate glass compositions were doped with cerium and terbium. Initial results indicated that these glasses, as they stood, had only a limited ability to dissolve the rare earth ions. A series of melt modifications was attempted to improve the solubility. ERA

N77-22474# Los Alamos Scientific Lab., N. Mex.
GRASER: A KINETICS CODE FOR STUDY OF NEUTRON-PUMPED GAMMA-RAY LASER SYSTEMS
John W. Pettit (Rensselaer Polytech. Inst., Troy, N. Y.) and George C. Baldwin (Rensselaer Polytech. Inst., Troy, N. y.) Sep. 1976 24 p
(Contract W-7405-eng-36)
(LA-6517-MS) Avail: NTIS HC A02/MF A01

Description, listing, sample plots, and operating instructions are given of a computer code for the CDC-6600 which calculates the time-dependence of populations of isomeric nuclear states and the time- and space-dependence of the vector potential of a plane wave of recoilless gamma radiation initiated by spontaneous emission and amplified by stimulated emission in a medium of specified properties. The code is based upon a continuous-function approximation of the neutron flux arising from a fast source burst of userspecified intensity in an infinite hydrogenous moderator. A variety of properties of the nuclear transition and of the medium may be specified by the user. ERA

N77-22475# Los Alamos Scientific Lab., N. Mex.
VERY HIGH INTENSITY REACTION CHAMBER DESIGN. VOLUME 2: STABLE RESONATOR ETALON
J. J. Devaney Aug. 1976 17 p refs
(Contract W-7405-eng-36)
(LA-6124-MS-Vol-2) Avail: NTIS HC A02/MF A01

Resonance conditions, optimization, finesse or Q, energy, intensity, and the characteristic time of a stable resonator etalon, formed of two focusing mirrors, are given. For use as a high-intensity irradiation device, the etalon mirror surfaces must be figured to small fractions of a wavelength. Consequently, practical applications with commercial-grade optics seem feasible at this time for the larger optical wavelengths only. In principle, for perfect optics (zero losses also), this device can infinitely magnify an infinitely long laser beam. It also has the advantage of refocusing each pass to precisely the same spot. In addition to its limited possibilities as a high-intensity irradiation device, this etalon resonator with its high selectivity and high rejection ratio, may have use as a frequency selecting or calibrating device, in common with the usual Fabry-Perot etalon, but with the

advantage of much higher intensities at resonance and at focus.
ERA

N77-22476# Sandia Labs., Albuquerque, N.Mex.
INEXPENSIVE SHIELDED dV/dt PROBE FOR HIGH VOLTAGE LASER APPLICATIONS
J. P. Anthes Oct. 1976 11 p refs
(Contract E(29-1)-789)
(SAND-76-0555) Avail: NTIS HC A02/MF A01

A high voltage, radio frequency-shielded probe was constructed by modifying an inexpensive BNC straight adaptor to monitor the voltage applied to a Pockels cell electro-optical gate. The probe permits rapid adjustment of the timing of the Pockels cell gate voltage to coincide with a single optical pulse of the pulse train from a mode-locked laser oscillator. ERA

N77-22477# Army Environmental Hygiene Agency, Aberdeen Proving Ground, Md.
NONIONIZING RADIATION PROTECTION SPECIAL STUDY: RECOMMENDED CONTROL METHODS FOR AIRBORNE INFRARED HIGH ENERGY LASER OPERATIONS Progress Report, Mar. 1975 - Aug. 1976
Terry L. Lyon 26 Oct. 1976 9 p
(AD-A031469; USAEHA-42-0139-77) Avail: NTIS HC A02/MF A01 CSCL 18/6

A nonionizing radiation protection special study was conducted to revise and recommend control methods for airborne infrared high energy laser operations. High energy lasers emit optical radiation greatly exceeding the current protection standards.
GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N77-22478* National Aeronautics and Space Administration. Pasadena Office, Calif.
ADJUSTABLE CHAMFERING TOOL Patent
William Halpern, inventor (to NASA) (JPL) Issued 18 Jan. 1972 4 p Filed 22 dec. 1969 Sponsored by NASA
(NASA-Case-NPO-10857-1; US-Patent-3,635,573; US-Patent-Appl-SN-886907; US-Patent-Class-408-186; US-Patent-Class-408-193; US-Patent-Class-408-225) Avail: US Patent Office CSCL 13I

A chamfering tool is disclosed having adjustable locking means to hold in a selected position on a twist drill. The chamfering tool has a set screw which is tightened to hold it in place, and locking means is a collar which is then slid down onto the top of the chamfering tool. The collar has a radial set screw which is tightened to engage a flute surface of the drill. The collar is canted in such a way as to lock the collar to the drill, and a second set screw is then tightened to hold the collar in its canted position. Official Gazette of the U.S. Patent Office.

N77-22479* National Aeronautics and Space Administration. Pasadena Office, Calif.
HYDRAULIC DRAIN MEANS FOR SERVO-SYSTEMS Patent
Gary L. Parker, inventor (to NASA) (JPL) Issued 18 Nov. 1969 3 p Filed 5 Feb. 1968 Sponsored by NASA
(NASA-Case-NPO-10316-1; US-Patent-3,478,514; US-Patent-Appl-SN-703107; US-Patent-Clas-s-60-53) Avail: US Patent Office CSCL 13I

A hydraulic servo drive for large loads, providing improved response at very low speeds, is described. The device includes a control system for providing substantial reduction in problems due to backlash and independent operation of motors, a pair of hydraulic drive motors connected in series with the fluid power source, and an auxiliary system for compensating for drain line loss. An orifice connected across each motor provides a source of fluid to the junction of the series connected motors.
Official Gazette of the U.S. Patent Office

N77-22480* National Aeronautics and Space Administration. Pasadena Office, Calif.
AUTOMATED MULTI-LEVEL VEHICLE PARKING SYSTEM Patent
Earl R. Collins (JPL) and Marshall E. Alper, inventors (to NASA) (JPL) Issued 29 Jul. 1975 12 p Filed 3 Oct. 1974 Sponsored by NASA
(NASA-Case-NPO-13058-1; NASA-Case-NPO-13096-1; US-Patent-3,896,955; US-Patent-Appl-SN-403154; US-Patent-Class-214-16.1CB) Avail: US Patent Office CSCL 13B

A multi-level garage in which vehicles are parked in parking stalls on any of a plurality of parking levels by means of elevator-supported transfer carts is described. Each parking stall consists of four multifinger spaced apart combs. Each transfer cart includes a top transfer plate with four spaced apart multifinger combs, the fingers of each comb being adapted to support a wheel of a vehicle positioned on the transfer plate. The latter is vertically movable with respect to the cart between a raised first position and a lowered second position. The stalls' fingers and the fingers of the transfer plate are arranged so that when the cart is moved from the elevator to any stall, the transfer plate is movable vertically between the two positions with the transfer plate fingers and the stall's fingers freely intermeshing.
Official Gazette of U.S. Patent Office.

N77-22481 Engineering Sciences Data Unit, London (England).
A GUIDE ON THE DESIGN AND SELECTION OF DRY RUBBING BEARINGS Data Item
Nov. 1976 43 p
(ESDU-76029; ISBN-0-85679-166-0) For information on availability of series, sub-series, or individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. (write for prices)

A novel approach for the design and selection of materials based on wear factors is adopted to obtain a procedure for evaluating performance in actual conditions of operation. Guidance is given on expected variation with temperature, bearing pressure, sliding speed, type of motion, mating surface roughness, environment, and many special requirements. The selection procedure considers the effect of each of these parameters, enabling suitable materials to be selected for given applications. Preferred and recommended practices are given for both thrust and journal bearing design, including guidance on dimensions, mating materials, running clearances, surface finish, installation, and machining. ESDU

N77-22482* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
MECHANICAL SEQUENCER Patent
Walter Thomas Appleberry, inventor (to NASA) (Rockwell Intern., Downey, Calif.) Issued 19 Apr. 1977 10 p Filed 17 Feb. 1976 Supersedes N76-19439 (14 - 10, p 1257) Sponsored by NASA
(NASA-Case-MSC-19536-1; US-Patent-4,018,092; US-Patent-Appl-SN-658450; US-Patent-Class-74-96) Avail: US Patent Office CSCL 13I

A mechanical sequencer having a rotatable drive shaft is described. The drive shaft has a spline formed thereon. A freely rotatable shaft contains a plurality of rollers positioned thereon, the axis of the freely rotatable shaft having an axis parallel to and offset from the axis of the drive shaft. A drive fitting has an opening therein, the drive fitting being positioned on the drive shaft spline for rotating the fitting with the shaft. A finger is formed integral with the drive fitting for enabling the fitting to move the rollers and the freely rotatable shift. A crank structure is positioned in a plane in a plane perpendicular to the axis of the drive shaft and the freely rotatable shaft. The crank structure has a drive shaft opening through which the shaft passes. The crank structure further contains a slot into which the freely rotatable shaft and one of the rollers extends for driving the crank structure during movement of the freely rotatable shaft. Official Gazette of the U.S. Patent Office

N77-22483*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Chemistry.
A FUNDAMENTAL APPROACH TO ADHESION: SYNTHESIS, SURFACE ANALYSIS, THERMODYNAMICS AND MECHANICS Final Report
David W. Dwight and James P. Wightman Feb. 1977 166 p refs

(Grant NsG-1124)
(NASA-CR-152672) Avail: NTIS HC A08/MF A01 CSCL 11A

The effects of composites as adherends was studied. Several other variables were studied by fractography: aluminum powder adhesive filler, fiber glass cloth scrim or adhesive carrier, new adhesives PPQ-413 and LARC-13, and strength-test temperature. When the new results were juxtaposed with previous work, it appeared that complex interactions between adhesive, adherend, bonding, and testing conditions govern the observed strength and fracture-surface features. The design parameters likely to have a significant effect upon strength-test results are listed. Author

N77-22484*# National Aeronautics and Space Administration, Washington, D. C.
SAFETY FLYWHEEL Patent Application
Richard T. Schneider, inventor (to NASA) (Fla. Univ., Gainesville) Filed 17 Jan. 1977 11 p Sponsored by NASA
(NASA-Case-HQN-10888-1; US-Patent-Appl-SN-760057) Avail: NTIS HC A02/MF A01 CSCL 13I

An inertial energy storage device is disclosed employing a safety flywheel which is made of flexible material such as a twisted rope ring. The rigidity required for such a device is achieved through centrifugal forces inherent in such a device when it is operating. A small number of the strands of the rope ring have a tensile strength that is lower than the vast majority of the strands of the rope ring whereby should any of these strands fail, they will begin to whiplash allowing such a failure to be detected and braked before a catastrophic failure occurs. This is accomplished by the inclusion of glass tubes located around the periphery of the flywheel. The tubes are in communication with a braking fluid reservoir. The flywheel and glass tubes are enclosed within a vacuum-tight housing. NASA

N77-22485# Bendix Corp., Kansas City, Mo.
DEBURRING CAPABILITIES FOR MINIATURE PRECISION PARTS
L. K. Gillespie Sep. 1976 97 p refs
(Contract E(29-1)-613)
(BDX-613-1604) Avail: NTIS HC A05/MF A01

Twenty-four deburring processes were studied to determine their applicability in the production of miniature precision metal components. Of interest was the manner in which the burr size affects the operating parameters of each deburring process, and the extent to which part size, surface finish, and edge radii are influenced by the various processes. Tests were performed on thirteen of the more promising processes. Data obtained from tests which involved 30,000 measurements are summarized along published literature, and discussions with vendors and users of deburring equipment. The data presented describe the mechanism by which each process operates, define its uses and limitations, and provide the best possible estimate of its quantitative effects. It is concluded that burrs having a major dimension of less than 25.4 micron (0.001 inch) can be removed by almost any process without adverse effects on part dimensions or surface finish. ERA

N77-22486# Bendix Corp., Kansas City, Mo.
FIXTURING AND HANDLING OF MINIATURE COMPONENTS
L. K. Gillespie Sep. 1976 40 p refs
(Contract E(29-1)-613)
(BDX-613-1482) Avail: NTIS HC A03/MF A01

Thirty approaches to fixturing, clamping, and handling of miniature precision components were studied, using a tooling boss to prevent damage and eliminate problems encountered in fabrication. Pencil type magnets with built-in release mechanisms also proved effective in handling operations. ERA

N77-22487# Bendix Corp., Kansas City, Mo.
FRACTURE MECHANICS TESTING CAPABILITY
M Ulitchny, G. Sep. 1976 17 p refs
(Contract E(29-1)-613)
(BDX-613-1531-Rev) Avail: NTIS HC A02/MF A01

A fracture mechanics testing facility is described. Included is the capability to perform fracture toughness (both static and dynamic), fatigue, J-integral, and notch sensitivity tests. ERA

N77-22488# Bendix Corp., Kansas City, Mo.
DEBURRING BY CENTRIFUGAL BARREL TUMBLING
L. K. Gillespie Aug. 1976 82 p refs
(Contract E(29-1)-613)
(BDX-613-1559) Avail: NTIS HC A05/MF A01

The reliability of small precision mechanisms greatly depends upon the production of burr-free, sharp-edged parts. Centrifugal barrel finishing (Harperizing), one of the few processes capable of producing these conditions, is discussed. Burrs less than 0.001-in. thick by 0.001-in. high are removed from 303 Se stainless steel, 1018 steel, and 6061-T6 aluminum with dimensional changes in the order of 0.0001-in and final edge radii of 0.003 in. These conditions are produced in batch lots in 20 minutes or less. Surface finishes are reduced from 45 to 25 or 35 microinches, with 60-minute cycle times. Stock losses appear to be repeatable within +-0.00006 in. Very small parts receive less action than parts 0.5 in. in dia. ERA

N77-22489# Bendix Corp., Kansas City, Mo.
EFFECTS OF DRILLING VARIABLES ON BURR PROPERTIES
L. K. Gillespie Sep. 1976 79 p refs
(Contract E(29-1)-0613)
(BDX-613-1502; PDO-6984405) Avail: NTIS HC A05/MF A01

The influence of drilling variables in controlling burr size was investigated to minimize burr-removal cost and improve the quality and reliability of parts for small precision mechanisms. Test samples were 303Se stainless steel, 17-4PH stainless steel, 1018 steel, and 6061-T6 aluminum. Burr thickness can be minimized by reducing feedrate and cutting velocity, and by using drills having high helix angles. High helix angles reduce burr thickness, length, and radius, while most other variables reduce only one of these properties. Radial-lip drills minimize burrs from 303Se stainless steel when large numbers of holes are drilled; this material stretches 10 percent before drill-breakthrough. Entrance burrs can be minimized by the use of subland drills at a greatly increased tool cost. Backup-rods used in cross-drilled holes may be difficult to remove and may scratch the hole walls. ERA

N77-22490# Southwest Research Inst., San Antonio, Tex. Army Fuels and Lubricants Research Lab.
PERFORMANCE OF ARMY ENGINES WITH UNLEADED GASOLINE-FIELD STUDY EVALUATION Final Report
John D. Tosh Oct. 1976 118 p refs
(Contracts DAAK02-75-C-0082; DAAD05-72-C-0427)
(AD-A032075; AFLRL-82) Avail: NTIS HC A06/MF A01 CSCL 21/4

All gasoline-powered vehicles and equipment at six U.S. Army installations were operated during the evaluation period on VV-G-001690A Regular Grade unleaded gasoline. Special Grade 91.0 RON unleaded gasoline was specified but was unavailable; therefore, unleaded gasoline in the 92.0-94.0 RON range was used throughout the program. During this evaluation period, no detrimental effects were noted on material handling equipment (MHE), engineer support equipment, or commercial, tactical, or combat vehicles operated under typical daily military operation. Also, no increases in maintenance operating costs were noted during this evaluation. Author (GRA)

N77-22491# Deposits and Composites, Inc., Herndon, Va.
TECHNOLOGY DEVELOPMENT OF A CVD SILICON CARBIDE RADIAL TURBINE ROTOR Interim Report
Richard E. Engdahl 18 Mar. 1976 87 p refs
(Contract DAAK02-74-C-0246)
(AD-A031595; DCI-113R-1) Avail: NTIS HC A05/MF A01 CSCL 21/5

The report describes an initial technology development effort with the goal of producing chemical vapor deposited (CVD) Silicon Carbide (SiC) radial inflow turbine rotors suitable for gas turbine applications. The work concentrated on optimizing the deposition parameters for producing CVD SiC material so as to obtain material with reduced residual stress, reduced flaw density and size and with thicknesses adequate for the rotor application. Work was also performed to determine a rotor shape that would have low rotational and thermal stresses and could be produced with high quality CVD SiC material. The optimization effort was successful

in reducing the as deposited residual stresses, flaw size and flaw density so that one half inch thick parts can now be routinely produced. GRA

N77-22492# National Bureau of Standards, Washington, D. C. Inst. for Materials Research.
STUDY OF INITIAL STAGES OF WEAR BY ELECTRON CHANNELING. 1: MEASUREMENT OF PLASTIC STRAIN IN COPPER DUE TO SLIDING WEAR. 2: QUANTITATIVE METHODS IN WEAR DEBRIS ANALYSIS Final Report
A. W. Ruff Oct. 1976 40 p refs
(Contract N00014-76-F-0012; NBS Proj. 3120438)
(AD-A031530; NBSIR-76-1141) Avail: NTIS HC A03/MF A01 CSCL 11/6

Wear experiments have been conducted to determine the plastic strains that are introduced in the surface material near sliding wear tracks. Both oil lubricated and dry sliding experiments have been carried out at different sliding distances on surfaces of copper. The strain values were determined from selected area electron channeling patterns obtained using a scanning electron microscope from regions as small as 10 micrometers in size and 0.05 micrometer deep around the wear track. A deformed calibration specimen was used to relate electron channeling band contrast to deformation strain. Wear debris has been removed from a number of test systems and analyzed using different methods. Those methods produced specific information concerning the particulate size and composition. A magnetic debris recovery method was quantitatively evaluated using actual debris samples and also using collections of manufactured particulates having known sizes and compositions. A comparison between chemical analysis and particulate analysis findings is presented. GRA

N77-22493# Ballistic Research Labs., Aberdeen Proving Ground, Md.
THE RESPONSE OF LINEAR UNSTABLE SYSTEMS TO STATIONARY GAUSSIAN EXCITATION Final Report
Pierre Lafrance Nov. 1976 19 p refs
(DA Proj. 1W1-61102-AH-43)
(AD-A032955; BRL-MR-2700) Avail: NTIS HC A02/MF A01 CSCL 12/1

When an unstable, linear mechanical system is perturbed by random ambient disturbances, the dynamical parameters (velocities, pressure) characterizing the system are themselves characterized by statistical and spectral distributions that can be directly evaluated from a statistical and spectral description of the random initial condition. This is a natural extension of the deterministic approach whereby a given initial condition (say, a sinusoidal perturbation) gives rise to a deterministic outcome (say, a time-increasing sinusoidal amplitude). While the deterministic approach is valid only when the initial conditions are known exactly, it must be superseded by a stochastic model when these conditions are known only in a statistical sense. This model is successfully applied to the breakup of liquid jets where turbulence is assumed to provide the random disturbance. Author (GRA)

N77-22494# California Univ., Irvine. School of Engineering.
THEORY OF SYSTEM TYPE FOR LINEAR MULTIVARIABLE SERVOMECHANISMS Interim Report
J. S. Meditch and C. A. Wolfe (Orincon, Inc., San Diego, Calif.) Jul. 1976 11 p refs Proc. of 1976 Joint Autom. Control Conf., West Lafayette, Ind., 27-30 Jul. 1976; sponsored by Am. Inst. of Chem. Engr., ASME, IEEE, Instrument Soc. of Am., and Soc. Mfg. Engr.
(Grants AF-AFOSR-2116-71; NSF GK-39735; AF Proj. 9769)
(AD-A032874; AFOSR-76-1192TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

A theory of system type for linear multivariable servomechanisms is developed. New characterizations of system type are formulated and two systematic methods for determining system types are derived. Both methods are algorithmic and easier to apply than the techniques given in earlier studies. The first applies to the case where the open-loop system is described by its transfer function matrix, the second where its time domain state-space representation is given. New results are also presented for characterizing and identifying the system type for certain composite systems from a knowledge of the individual subsystem types. Author (GRA)

N77-22495# California Univ., Irvine. School of Engineering.
PRE- AND POST-COMPENSATION TO ACHIEVE SYSTEM TYPE IN LINEAR MULTIVARIABLE SERVOMECHANISMS Interim Report
C. A. Wolfe (Orincon, San Diego, Calif.) and J. S. Meditch Jul. 1976 8 p refs Proc. of The 1976 Joint Autom. Control Conf., West Lafayette, Ind., 27-30 Jul. 1976; sponsored by Am. Inst. of Chem. Engr., ASMF, IEEE Instrument Soc. of Am., Soc. Mfg. Engr.
(Grants AF-AFOSR-2116-71; NSF GK-39735; AF Proj. 9769)
(AD-A032873; AFOSR-76-1191TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

Methods for specifying pre- and post-compensation to achieve a desired system type in linear multivariable servomechanisms are developed. Sufficient conditions are derived for both forms of compensation when the compensator is restricted to a diagonal input-output representation, and a method for realizing reduced-order precompensators is presented for the case where the restriction is removed. Author (GRA)

N77-22496# Massachusetts Univ., Amherst. Dept. of Civil Engineering.
MEAN-SQUARE RESPONSE OF A NONLINEAR SYSTEM TO NONSTATIONARY RANDOM EXCITATION Interim Report
Hidekichi Kanematsu and William A. Nash Aug. 1976 63 p refs
(Grant AF-AFOSR-2340-72)
(AD-A033288; AFOSR-76-1243TR) Avail: NTIS HC A04/MF A01 CSCL 12/1

The transient mean-square response of a nonlinear single degree of freedom mechanical system to nonstationary random excitation characterized by the product of an envelope function and stationary Gaussian random process is determined by the equivalent linearization technique. A unit step envelope function is considered in conjunction with both correlated and white noise with zero mean. It has been shown that for white noise modulated by a unit step function, the transient mean-square response never exceeds the stationary response. However, the mean-square response to correlated noise modulated by a unit step function may exceed its stationary value. The analysis is extended to the multi-degree-of-freedom nonlinear system for the case of mutually uncorrelated noise. Author (GRA)

N77-22497# AiResearch Mfg. Co., Torrance, Calif.
HIGH POWER STUDY: CONVENTIONAL GENERATORS, SUPERCONDUCTING GENERATORS, NON-AIR-BREATHING TURBINES Final Report, Jun. - Dec. 1975
Leon Schipper 22 Jul. 1976 385 p
(Contract F33615-75-C-2071)
(AD-A032634; AiResearch-76-12446; AFAPL-TR-76-39) Avail: NTIS HC A17/MF A01 CSCL 10/2

In this study, parametric data and key computer codes were developed and point designs evaluated on the subject of conventional generators, superconducting generators, and non-air-breathing turbines for high-power airborne application. In addition, a set of development and technology programs was developed as a means to enhance rapid development or reduce the technical risk of the various components. Author (GRA)

N77-22498# DARCOM Intern Training Center, Texarkana, Tex.
INVESTIGATION OF AN AUTOMATED MATERIALS HANDLING SYSTEM USING A GPSS SIMULATION Final Report
Ronald J. Rosenthal Nov. 1976 50 p refs
(AD-A032700; DARCOM-ITC-02-08-76-225) Avail: NTIS HC A03/MF A01 CSCL 13/8

This is a report of an investigation of the validity of a conceptual automated material handling system with tool, machine, and transfer mechanism failures. The development of a modular GPSS simulation model is used to study and analyze the system. The modular design makes it a good basis for construction of more complex models of larger similar physical concepts. The larger models are easily generated through the use of macros. Author (GRA)

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N77-22499# Yang, Stevens, Fabian, Engineers, New York.
NONDESTRUCTIVE EVALUATION OF CIVIL AIRPORT PAVEMENTS Final Report
Nai C. Yang Sep. 1976 139 p refs Sponsored in part by FAA
(Contract DACW39-76-C-0010)
(AD-A036384; FAA-RD-76-83) Avail: NTIS HC A07/MF A01 CSCL 13/2

The nondestructive test is used to define the physical conditions of an existing pavement system without destroying it. The frequency sweep NDT was introduced to replace conventional plate bearing tests. A 16 kip vibrator has conducted such tests at 15 civil airports. The NDT test procedures have now been standardized, and the results can automatically be included in the functional pavement design and evaluation program. The computer program consists of three subsystems. The fist subsystem relates aircraft response to pavement smoothness. The pavement structure's capacity to withstand repeated aircraft loadings is related to the user's requirements, the demand forecast and the need for maintenance. The second subsystem determines the pavement thickness and composition required to meet the tolerances defined in the first subsystem. The third subsystem evaluates the cost/benefit aspects of design alternatives. Author

N77-22500# Los Alamos Scientific Lab., N. Mex.
BAYESIAN ZERO-FAILURE (BAZE) RELIABILITY DEMONSTRATION TESTING PROCEDURE AND ITS APPLICATION TO A RANKINE DYNAMIC RADIOISOTOPE POWER CONVERSION SYSTEM
H. F. Martz, Jr. and R. A. Waller Jul. 1976 50 p refs
(Contract W-7405-eng-36)
(LA-6421-MS) Avail: NTIS HC A03/MF A01

A Bayesian Zero-Failure (BAZE) reliability demonstration testing procedure was developed. The procedure may be used to verify component failure rates associated with both real-time dependent and cycle-dependent chance failure mechanisms. A constant failure-rate model with a gamma prior distribution is assumed. The procedure is used to obtain sample test plans for components of a proposed Rankine power conversion system. ERA

N77-22501# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT OF A NON-DESTRUCTIVE INSPECTION TECHNIQUE FOR ADVANCED COMPOSITE MATERIALS USING CHOLESTERIC LIQUID CRYSTALS M.S. Thesis
Robert Troy Schaum Sep. 1976 65 p refs
(AD-A032322) Avail: NTIS HC A04/MF A01 CSCL 11/4

A new, relatively simple and inexpensive non-destructive inspection technique for advanced composite materials is proposed, and its feasibility is demonstrated. This technique uses encapsulated cholesteric liquid crystals to sense small temperature differences which result from nonuniform heat transfer through composites. Discontinuities in heat transfer evidenced by contrasting surface color patterns indicate material discontinuities, i.e. flaws. Preliminary investigations into the thermal conductivity of a .041 in. thick graphite/epoxy laminated panel in the direction normal to the composite laminae and in the direction parallel to the laminae are described. The coefficients of conductivity in the two directions were found to differ by an order of magnitude. A qualitative test of the technique in locating embedded teflon triangles is reported, and a design for a testing device is proposed. Author (GRA)

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N77-22502 Engineering Sciences Data Unit, London (England).
BUCKLING OF STRUTS. LIPPED AND UNLIPPED CHANNEL SECTIONS Data Item
Nov. 1976 20 p
(ESDU-76023; ISBN-0-85679-160-1) For information on availability of series, sub-series, or individual data items, write NTIS, Attn: ESDU, Springfield, Va. 22161. (write for prices)

Charts are presented which relate the compressive stress at buckling to the associated half-wavelength for lipped and unlipped channel section struts of isotropic material. The data include the effects of translation, rotation, and distortion of the strut cross section and cover the practical range of flange and lip proportions and buckle half-wavelengths. Curves giving material plasticity correction factors are also provided. Typical applications include aircraft ribs, floor and seat supports. ESDU

N77-22503*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEMINAR ON UNDERSTANDING DIGITAL CONTROL AND ANALYSIS IN VIBRATION TEST SYSTEMS, PART 2
Washington, D.C. Shock and Vibration Information Center May 1975 113 p refs Conf. Proc. held at Greenbelt, Md., 17-18 Jun. 1975, and at Pasadena, Calif., 22-23 Jul. 1975 Sponsored in part by JPL and the Shock and Vibration Information Center
(NASA-TM-X-74684) Avail: NTIS HC A06/MF A01 CSCL 13M

A number of techniques for dealing with important technical aspects of the random vibration control problem are described. These include the generation of pseudo-random and true random noise, the control spectrum estimation problem, the accuracy/speed tradeoff, and control correction strategies. System hardware, the operator-system interface, safety features, and operational capabilities of sophisticated digital random vibration control systems are also discussed. Author

N77-22504# Shock and Vibration Information Center (Defense), Washington, D.C. Naval Research Lab.
THE SHOCK AND VIBRATION DIGEST, VOLUME 8, NO. 7
Jul. 1976 97 p
(AD-A027392) Avail: NTIS HC A05/MF A01

Methods are discussed for shock and vibration measurement analysis in the design of instruments and nuclear reactors. Applications of the calculus of variations in engineering and science are explored. For individual titles, see N77-22505 through N77-22507.

N77-22505# Commonwealth Scientific and Industrial Research Organization, Sydney (Australia). National Measurement Lab.
VIBRATION ISOLATING MOUNTINGS FOR SENSITIVE EQUIPMENT: NEW DESIGN CRITERIA
J. A. Macinante *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, no. 7 Jul. 1976 p 3-24 refs (For primary document see N77-22504 13-39)
Avail: NTIS HC A05/MF A01

The relative response of a particular element or equipment component is considered as a quality of vibration isolation. A practical method is given for deciding suitable values for the natural frequencies of a mounting for equipment having a critical element of given characteristics and subjected to damped harmonic or steady state vibration of a given frequency. Author

N77-22506# Bolt, Beranek, and Newman, Inc., Cambridge, Mass. Dynamics and Structural Group.
VARIATIONAL METHODS OF ANALYSIS
Clive L. Dym *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, no. 7 Jul. 1976 p 27-31 refs (For primary document see N77-22504 13-39)
Avail: NTIS HC A05/MF A01

Applications of the calculus of variations in engineering and

science are reviewed from literature abstracted or cited in Shock and Vibration Digest in 1975. Included is a bibliography of 68 texts or monographs available on the development and use of variational methods. Author

N77-22507# Argonne National Lab., Ill.
FLOW-INDUCED VIBRATION OF NUCLEAR REACTOR SYSTEM COMPONENTS
T. M. Mulcahy and M. W. Wambsganss *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, no. 7 Jul. 1976 p 33-45 refs (For primary document see N77-22504 13-39)
Avail: NTIS HC A05/MF A01

The mechanisms of flow induced vibrations are discussed. Fluid induced vibration potentials of typical reactor configurations are illustrated. Current methods used in reactor design evaluation are reviewed and assessed. Author

N77-22508# Shock and Vibration Information Center (Defense), Washington, D.C. Naval Research Lab.
THE SHOCK AND VIBRATION DIGEST, VOLUME 8, NO. 2
Aug. 1976 101 p
(AD-A029222) Avail: NTIS HC A06/MF A01 CSCL 13/13

Structural vibration is analyzed and modeled for cylinders, fluid-filled membranes, and other elastic bodies. For individual titles, see N77-22509 through N77-22511.

N77-22509# Technical Univ. of Denmark, Lyngby. Dept. of Solid Mechanics.
A SURVEY OF THE OPTIMAL DESIGN OF VIBRATING STRUCTURAL ELEMENTS. PART 1: THEORY
Niels Olhoff *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 2 Aug. 1976 p 3-10 refs (For primary document see N77-22508 13-39)
Avail: NTIS HC A06/MF A01 CSCL 13M

The optimal design of elastic structural elements undergoing free vibrations is discussed. The unified variational technique is used to minimize the material volume of a one- or two-dimensional continuous element with a specific natural frequency. Author

N77-22510# Waterloo Univ. (Ontario). Solid Mechanics Div.
THE VIBRATION OF CYLINDERS
G. M. L. Gladwell *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 2 Aug. 1976 p 13-34 refs (For primary document see N77-22508 13-39)
Avail: NTIS HC A06/MF A01 CSCL 13M

The set of differential equations and boundary conditions governing the vibrations of a cylinder of finite length may be solved in closed form only for certain very simple boundary conditions. Cylinder vibrations were analyzed to replace the governing equations by simpler ones, and to assess the errors incurred by such approximations. Topics discussed include: analysis of the exact equations for infinite and certain finite cylinders; the quasi-analytical tri-mode theory of Mindlin and McNiven; finite difference and finite element theories; and the determination of errors incurred by using shell theories. Author

N77-22511# Ohio State Univ., Columbus.
ON THE LARGE-DEFORMATION THEORY OF FLUID-FILLED SHELLS OF REVOLUTION
Ali E. Engin *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 2 Aug. 1976 p 35-47 refs (For primary document see N77-22508 13-39)
Avail: NTIS HC A06/MF A01 CSCL 13M

The fundamentals of the theory of large displacements and strains of fluid-filled shells of revolution are discussed. A summary of the equations of motion of an arbitrary shell is given. The equations of motion for membrane shells of revolution are obtained and modified to include large deformations. Stress-strain relations for isotropic and incompressible shell material are expressed by a strain energy function, W, which can represent highly nonlinear behavior of biological tissues. A hydrodynamic pressure expression is derived for application to biological systems composed of fluid filled membranes, in which can occur large displacements, rotations, and large elastic strains, such as in abdominal injury. Author

N77-22512# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 8, NO. 9
Sep. 1976 92 p refs
(AD-A030014) Avail: NTIS HC A05/MF A01

Papers on sound, shock, and vibration technology are presented. Specific topics discussed include: vibration of structural elements and grid works and control of vibration of buildings. For individual titles, see N77-22513 through N77-22515.

N77-22513# Technical Univ. of Denmark, Lyngby. Dept. of Solid Mechanics.
A SURVEY OF THE OPTIMAL DESIGN OF VIBRATING STRUCTURAL ELEMENTS. PART 2: APPLICATIONS
Niels Olhoff *In* Shock and Vibration Inform. Center (Defense) Shock and Vibration Dig., Vol. 8, No. 9 Sep. 1976 p 3-10 refs (For primary document see N77-22512 13-39)
Avail: NTIS HC A02/MF A01

The optimal design of elastic structural elements undergoing free vibrations is reviewed. The unified variational technique is used to minimize the material volume of a one- or two-dimensional continuous element with a specific natural frequency. Author

N77-22514# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PREDICTION AND CONTROL OF VIBRATIONS IN BUILDINGS
Eric E. Unger, Clive L. Dym, and Robert W. White *In* Shock and Vibration Inform. Center (Defense) Shock and Vibration Dig., Vol. 8, No. 9 Sep. 1976 p 13-24 refs (For primary document see N77-22512 13-39)
Avail: NTIS HC A02/MF A01

The engineering tools available for estimating building vibrations caused by external noise sources and unsteady air pressures, internal vibration sources associated with machinery and human activity, and external ground excitation associated with traffic and construction are surveyed. Criteria for personnel, structures, and equipment are indicated. Methods for reducing building vibrations are discussed. Author

N77-22515# West Virginia Univ., Morgantown. Dept. of Civil Engineering.
VIBRATION ANALYSIS OF GRID-WORKS
Hota V. S. GangaRao *In* Shock and Vibration Inform. Center (Defense) Shock and Vibration Dig., Vol. 8, No. 9 Sep. 1976 p 25-30 refs (For primary document see N77-22512 13-39)
Avail: NTIS HC A02/MF A01

Several mathematical techniques that have been used to analyze planar grid-works and grid-work shells under dynamic loads are described. Numerical methods are used to determine differences between distributed versus lumped mass idealizations, torsional effects, boundary variations, spacing and stiffness of beams. Author

N77-22516# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 8, NO. 10
Oct. 1976 112 p
(AD-A031701) Avail: NTIS HC A06/MF A01 CSCL 13/13

Various aspects of vibration damping technology are reviewed. Specific areas covered include: damping of dynamic systems, dynamic characteristics of rail vehicles, and the fundamentals of composite and laminate behavior. For individual titles, see N77-22517 through N77-22519.

N77-22517# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
HIGH TEMPERATURE DAMPING OF DYNAMIC SYSTEMS
David I. G. Jones *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 10 Oct. 1976 p 3-16 refs (For primary document see N77-22516 13-39)
Avail: NTIS HC A06/MF A01

High temperature vibration control technology is surveyed. Analysis of frictional damping in systems, allowance for impacting surfaces, development of multiple metal energy absorbing composites, and development of measurement techniques are discussed along with development of a data base of damping behavior of enamels or glasses as a function of composition

and processing, development of simple finite element analyses of response of components damped by enamel or glass coatings or inserts, including multiple materials systems, and development of design data for jet engine components heat transfer systems, exhaust systems as damped by elastomers, enamels, glasses, or other means. Author

N77-22518# Illinois Inst. of Tech., Chicago.
NONLINEAR ANALYSIS OF RAIL VEHICLE DYNAMICS
T. Willis *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 10 Oct. 1976 p 19-35 refs (For primary document see N77-22516 13-39)
Avail: NTIS HC A06/MF A01

Rail vehicle dynamics research is surveyed in terms of the analytical determination of the dynamic response of rail cars to rail input. The nature of rail vehicles and the dynamic loads they experience are briefly described. Summaries of studies being conducted in other areas of rail dynamics research are included. Author

N77-22519# Oklahoma Univ., Norman. School of Aerospace, Mechanical and Nuclear Engineering.
DAMPING OF COMPOSITE AND SANDWICH PANELS, PART 1
Charles W. Bert *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 8, No. 10 Oct. 1976 p 37-48 refs (For primary document see N77-22516 13-39)
Avail: NTIS

The literature pertaining to the dynamics of composite and sandwich panels is surveyed. Emphasis is placed on flexural motion, elastic and viscoelastic behavior of materials, and free vibration. Author

N77-22520# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 9, NO. 1
Jan. 1977 94 p
(AD-A035310) Avail: NTIS HC A05/MF A01 CSCL 13/13

Helicopter airframe vibration, shock and vibration measuring instruments, and computer programs dealing with vibration isolation are briefly discussed. For individual titles, see N77-22521 through N77-22523.

N77-22521# Edinburgh Univ. (Scotland). Dept. of Mechanical Engineering.
VIBRATION OF HELICOPTERS
G. T. S. Done *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 1 Jan. 1977 p 5-14 refs (For primary document see N77-22520 13-39)
Avail: NTIS HC A05/MF A01

Helicopter airframe forced vibration excitation and response are considered. Methods and hardware for vibration control including structural modification, isolation, absorbers, and rotor control are described. Author

N77-22522# Harza Engineering Co., Chicago, Ill.
SHOCK AND VIBRATION INSTRUMENTATION. ACCELEROMETERS
W. S. Mitchell *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 1 Jan. 1977 p 15-18 refs (For primary document see N77-22520 13-39)
Avail: NTIS HC A05/MF A01

Transducer design, signal conditioning equipment, and acceleration measurement applications are considered. Acceleration transducers available for measuring almost any motion from near d.c. to 100 kHz are described. Temperature, sensitivity, fidelity, and dependability are among the characteristics discussed. Author

N77-22523# Wright (Barry) Corp., Watertown, Mass.
COMPUTER PROGRAMS: SHOCK AND VIBRATION ISOLATION
Thomas F. Derby *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 1 Jan. 1977 p 19-26 refs (For primary document see N77-22520 13-39)
Avail: NTIS HC A05/MF A01

Shock and vibration isolation problems and the modeling and mathematical techniques used to solve them are described along with available computer programs. Author

N77-22524# Shock and Vibration Information Center (Defense), Washington, D.C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 9, NO. 2
Feb. 1977 95 p refs
(AD-A035879) Avail: NTIS HC A05/MF A01 CSCL 13/13

Vibration absorption and isolation, damping of fiber-reinforced composite materials, and application of finite element analysis to structural vibration problems are considered. For individual titles, see N77-22525 through N77-22527.

N77-22525# Iowa State Univ. of Science and Technology, Ames.
DYNAMIC STIFFNESS AND DAMPING OF FIBER-REINFORCED COMPOSITE MATERIALS
R. F. Gibson and R. Plunkett (Minn. Univ., Minneapolis) *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 2 Feb. 1977 p 9-18 refs (For primary document see N77-22524 13-39)
Avail: NTIS HC A05/MF A01

Experimental and analytical efforts to characterize the dynamic mechanical properties of fiber-reinforced composite materials are reviewed. Author

N77-22526# Florida Univ., Gainesville.
ABSORBERS AND ISOLATORS FOR TORSIONAL VIBRATION
John M. Vance *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 2 Feb. 1977 p 19-37 refs (For primary document see N77-22524 13-39)
Avail: NTIS HC A05/MF A01

Devices used for reducing torsional vibration in rotating machinery are described. Consistent definitions are given for absorbers, isolators, and dampers. Author

N77-22527# Indian Inst. of Science, Bangalore.
FINITE ELEMENT MODELING OF NATURAL VIBRATION PROBLEMS
A. V. Krishna Murty *In* The Shock and Vibration Inform. Center The Shock and Vibration Digest, Vol. 9, No. 2 Feb. 1977 p 19-35 refs (For primary document see N77-22524 13-39)
Avail: NTIS HC A05/MF A01

Finite element modeling techniques are reviewed, including lumped parameter, transfer matrix, finite element displacement, finite element force, hybrid and quadratic eigenvalue methods. Applications of the methods to natural vibration problems are given. Author

N77-22528*# Boeing Aerospace Co., Seattle, Wash.
THE BOEING PLASTIC ANALYSIS CAPABILITY FOR ENGINES Final Report
R. G. Vos 25 Dec. 1976 359 p refs
(Contract NAS8-30615)
(NASA-CR-150246; D180-20229) Avail: NTIS HC A16/MF A01 CSCL 13M

The current BOPACE program is described as a nonlinear stress analysis program, which is based on a family of isoparametric finite elements. The theoretical, user, programmer, preprocessing aspects are discussed, and example problems are included. New features in the current program version include substructuring, an out-of-core Gauss wavefront equation solver, multipoint constraints, combined material and geometric nonlinearities, automatic calculation of inertia effects, provision for distributed as well as concentrated mechanical loads, follower forces, singular crack-tip elements, the SAIL automatic generation capability, and expanded user control over input quantity definition, output selection, and program execution. BOPACE is written in FORTRAN 4 and is currently available for both the IBM 360/370 and the UNIVAC 1108 machines. Author

N77-22529# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
PAVEMENT PERFORMANCE MODELS. VOLUME 1: REPEATED LOAD FRACTURE OF PAVEMENT SYSTEMS Final Report, May 1974 - Nov. 1975
Matthew W. Witczak Aug. 1976 197 p refs 2 Vol.

(Contract DOT-FA73WAI-377; DA Proj. 4A7-62719-AT-40)
(AD-A035873/9; FAA-RD-75-227-Vol-1) Avail: NTIS HC A09/MF A01 CSCL 13/2

A comprehensive summary touching upon laboratory test procedures, test methods, influence of mix factors upon fatigue, generation of typical fatigue curves, development of fatigue fracture subsystems, and verification studies is presented. The state of the art is summarized and qualitatively rated relative to eleven different features felt to be necessary for the development of a fatigue subsystem. In addition, this summary formed the basis for recommendations dealing with future research on fatigue. The basis of the fatigue subsystem is formulated upon the concept that any such methodology proposed for fracture distress must ultimately be founded upon a functional pavement failure.
Author

N77-22530*# Sheldahl Co., Northfield, Minn.
INVESTIGATION OF KEVLAR FABRIC-BASED MATERIALS FOR USE WITH INFLATABLE STRUCTURES Final Report
R. J. Niccum, J. B. Munson, and L. L. Rueter Washington NASA Apr. 1977 87 p refs
(Contract NAS1-12701)
(NASA-CR-2724) Avail: NTIS HC A05/MF A01 CSCL 11D

Design, manufacture and testing of laminated and coated composite materials incorporating a structural matrix of Kevlar are reported. The practicality of using Kevlar in aerostat materials is demonstrated, and data are provided on practical weaves, lamination and coating particulars, rigidity, strength, weight, elastic coefficients, abrasion resistance, crease effects, peel strength, blocking tendencies, helium permeability, and fabrication techniques. Properties of the Kevlar-based materials are compared with conventional Dacron-reinforced counterparts. A comprehensive test and qualification program is discussed, and considerable quantitative biaxial tensile and shear test data are provided.
Author

N77-22531*# General Dynamics/Convair, San Diego, Calif.
EVALUATION OF COATED COLUMBIUM ALLOY HEAT SHIELDS FOR SPACE SHUTTLE THERMAL PROTECTION SYSTEM APPLICATION Final Report
W. E. Black Washington NASA Apr. 1977 67 p refs
(Contract NAS1-9793)
(NASA-CR-2824; CASD-NAS-76-056) Avail: NTIS HC A04/MF A01 CSCL 20D

A three-phase program to develop and demonstrate the feasibility of a metallic heat shield suitable for use on Space Shuttle Orbiter class vehicles at operating surface temperatures of up to 1590 K (2400 F) is summarized. An orderly progression of configuration studies, material screening tests, and subscale structural tests was performed. Scale-up feasibility was demonstrated in the final phase when a sizable nine-panel array was fabricated and successfully tested. The full-scale tests included cyclic testing at reduced air pressure to 1590 K (2400 F) and up to 158 dB overall sound pressure level. The selected structural configuration and design techniques succesfully eliminated thermal induced failures. The thermal/structural performance of the system was repeatedly demonstrated. Practical and effective field repair methods for coated columbium alloys were demonstrated. Major uncertainties of accessibility, refurbishability, and durability were eliminated.
Author

N77-22532# Oak Ridge National Lab., Tenn.
EVALUATION OF THE BOLTING AND FLANGES OF ANSI B16.5 FLANGED JOINTS: ASME PART A DESIGN RULES
E. C. Rodabaugh and S. E. Moore 20 Aug. 1976 180 p refs
Prepared in cooperation with Battelle Columbus Labs., Ohio
(Contract W-7405-eng-26)
(ORNL/SUB-2913-3; NRC-5; PR-115-7b) Avail: NTIS HC A09/MF A01

Simple and conservative methods for assessing the adequacy of piping products used in Code Class-1, Class-2, and Class-3 piping systems were developed. Evaluations of ANSI B16.5 flanged joints provide the basis for equations recommended for inclusion in revisions to the Code.
ERA

N77-22533# Oak Ridge National Lab., Tenn.
REVIEW OF CONCRETE PROPERTIES FOR PRESTRESSED CONCRETE PRESSURE VESSELS
R. K. Nanstad Oct. 1976 120 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5497) Avail: NTIS HC A06/MF A01

The desire for increasing power output along with safety requirements has resulted in consideration of the prestressed concrete pressure vessel (PCPV) for most current nuclear reactor systems, as well as for the very-high-temperature reactor for process heat and as primary pressure vessels for coal conversion systems. Results are presented of a literature review to ascertain current knowledge regarding plain concrete properties under conditions imposed by a mass concrete structure such as PCRV. The effects of high temperature on such properties as strength, elasticity, and creep are discussed, as well as changes in thermal properties, multiaxial behavior, and the mechanisms thought to be responsible for the observed behavior. In addition, the effects of radiation and moisture migration are discussed. It is concluded that testing results found in the technical literature show much disagreement as to the effects of temperature on concrete properties. The variations in concrete mixtures, curing and testing procedures, age at loading, and moisture conditions during exposure and testing are some of the reasons for such disagreement.
ERA

N77-22534# Hanford Engineering Development Lab., Richland, Wash.
LASER INTERFEROMETER SYSTEM FOR THE MEASUREMENT OF CREEP IN PRESSURIZED TUBES
T. L. Kirchner Jul. 1976 18 p refs
(HEDL-SA-1101) Avail: NTIS HC A02/MF A01

A laser interferometer measurement system was developed to measure the length, diameter, and radius of various pressurized tube specimens. The machine measures and records profilometric data of the pressurized tubes prior to insertion in the reactor and then again after a predetermined fluence was reached to determine the amount of creep which has occurred. Data provide a statistical basis for the description of steady-state in-reactor creep and creep rupture behavior of the reference fuel cladding and structural materials for the Fast Flux Test Facility and the Clinch River Breeder Reactor. In addition, this data will be used to determine the relative in-reactor creep and creep rupture behavior of candidate alloys for advanced cladding and structural materials.
ERA

N77-22535# Battelle Columbus Labs., Ohio.
APPROPRIATE NOMINAL STRESSES FOR USE WITH ASME CODE PRESSURE-LOADING STRESS INDICES FOR NOZZLES
E. C. Rodabaugh Jun. 1976 60 p refs Prepared for Oak Ridge National Lab.
(Contract W-7405-eng-26)
(ORNL-Sub-2913-2) Avail: NTIS HC A04/MF A01

This program is part of a cooperative effort with industry to develop and verify analytical methods for assessing the safety of nuclear pressure-vessel and piping-system design. The study of nominal stresses and stress indices described is part of a continuing study of design rules for nozzles in pressure vessels being coordinated by the PVRC Subcommittee on Reinforced Openings and External Loadings. Results from these studies are used by appropriate ASME Code groups in drafting new and improved design rules.
ERA

N77-22536# Oak Ridge National Lab., Tenn. Reactor Div.
TEST OF 6-IN.-THICK PRESSURE VESSELS. SERIES 3: INTERMEDIATE TEST VESSEL V-7
J. G. Merkle, G. C. Robinson, P. P. Holz, J. E. Smith, and R. H. Bryan Aug. 1976 123 p refs
(Contract W-7405-eng-26)
(ORNL-NUREG-1) Avail: NTIS HC A06/MF A01

The vessel was heated to 91 C (196 F) and pressurized hydraulically until leakage through the flaw terminated the test at a peak pressure of 147 MPa (21,350 psi). Fracture toughness data obtained by testing precracked Charpy 5 and compact-tension specimens machined from a prolongation of the cylindrical test shell were used in pretest analyses of the flawed vessel. The vessel, as expected, did not burst. Upon depressurization, the ruptured ligament closed so as to maintain static pressure without leakage at about 129 MPa (18,700 psi).
ERA

N77-22537# Cornell Univ., Ithaca, N.Y. Dept. of Theoretical and Applied Mechanics.
CREEP OF BEAMS USING A STATE-VARIABLE APPROACH
Y. C. Waung and R. H. Lance Jul. 1976 35 p refs
(Contract E(11-1)-2733)
(COO-2733-6) Avail: NTIS HC A03/MF A01

The technical theory of bending of beams is formulated in terms of Hart's state-variable equations. The bending of rectangular beams under constant and variable moments is then solved by a standard routine. The stationary creep of a beam in pure bending is obtained in closed form; this analysis serves as a check of some of the transient creep computations. Results compare qualitatively with those using classical creep theories and in addition they show the strong-influence upon creep deformation of the state-variable called hardness, which is absent in the other theories. ERA

N77-22538# Sandia Labs., Livermore, Calif.
ADHESION TESTING OF DEPOSIT-SUBSTRATE COMBINATIONS
J. W. Dini and H. R. Johnson Sep. 1976 44 p refs
(Contract AT(29-1)-789)
(SAND-76-8507) Avail: NTIS HC A03/MF A01

For quantitative measurements of adhesion in coating-substrate combinations, the means most often used at Sandia Laboratories are ring shear, conical-head tensile, and I-beam tensile tests. Details presented for each test include specimen size, shape, and preparation, and the manner in which the test is performed. Pros and cons of each test are discussed in the light of substantial practical experience, and data for the various deposit-substrate combinations are included. ERA

N77-22539# Dundee Univ. (Scotland). Dept. of Mechanical Engineering.
PARAMETRIC AND NONLINEAR MODE INTERACTION BEHAVIOUR IN THE DYNAMICS OF STRUCTURES Interim Scientific Report
A. D. S. Barr and R. P. Ashworth 1976 28 p refs
(Grant AF-AFOSR-2723-74; AF Proj. 9782)
(AD-A031323; AFOSR-76-1131TR) Avail: NTIS HC A03/MF A01 CSCL 20/11

This report describes the behaviour of structures under internal resonance conditions. Completion of the analysis on the three mode interaction case yields the variational equations describing the slowly varying amplitudes and phases of each mode. Computer simulation (C.S.M.P.) of these equations has been carried out. Both parametric and nonlinear terms are found to be of importance in the response of the structure. Further experimental work on the original four mode model, where parametric excitation of two of the modes leads to eventual participation of all the modes, is presented along with a theoretical approach of a more general nature. Attention is then turned to a less complex two-mode system exhibiting both parametric and nonlinear behaviour. GRA

N77-22540# Battelle Columbus Labs., Ohio.
THREE DIMENSIONAL STRESS ANALYSIS OF A LAMINATED PLATE CONTAINING AN ELLIPTICAL CAVITY Final Report, Dec. 1973 - Dec. 1974
Edmund F. Rybicki and David W. Schmueser Wright-Patterson AFB, Ohio AFML Apr. 1976 42 p refs
(Contract F33615-74-C-5096)
(AD-A031432; AFML-TR-76-32) Avail: NTIS HC A03/MF A01 CSCL 11/7

An analysis procedure is developed to study the stress distribution in a laminated plate containing an elliptical cavity under tensile loading and a uniform temperature change. Also considered is the stress field around a radial crack emanating from a hole in a laminate. The analysis follows from an extension of a previously developed finite element approach. Author (GRA)

N77-22541# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF STRESS DETERMINATION FOR AIRCRAFT FATIGUE LIFE ESTIMATION FROM IN-FLIGHT STRAIN DATA M.S. Thesis
George Michael Horne Sep. 1976 141 p refs
(AD-A031870) Avail: NTIS HC A07/MF A01 CSCL 11/6

A thorough knowledge of localized stresses due to geometric effects is necessary for accurate fatigue life estimation in aircraft structures. The Department of Aeronautics, Naval Postgraduate School, Monterey, California, has developed a strain monitoring system that provides data on nominal stresses experienced by aircraft structures, which can be applied to obtain local stresses at a stress concentration, provided a local stress vs. nominal strain relationship is available. A theory proposed by Neuber lends itself to development of a method by which local stress can be obtained with knowledge of nominal strain and material properties alone. Stress relaxation behavior was obtained for two cyclic loading histories of plate specimens in an effort to extend the monotonic local stress vs. nominal strain relationships into practical use for fatigue life estimation of aircraft structures. GRA

N77-22542# Naval Surface Weapons Center, Dahlgren, Va.
DYNAMIC YIELD STRESS AND ELASTIC WAVE VELOCITY MEASUREMENTS FOR HF-1 STEEL Final Report
W. Mock, Jr., W. H. Holt, and C. R. Crowe Sep. 1976 19 p refs
(AD-A031392; NSWC/DL-TR-3519) Avail: NTIS HC A02/MF A01 CSCL 11/6

Shock wave and ultrasonic measurements have been performed on HF-1 steel, heat treated to RC 40 hardness. The dynamic yield stress and elastic wave velocity were determined from precision gas gun experiments. Ultrasonic longitudinal and shear wave velocities were obtained with the pulse-echo technique; Poisson's ratio, Young's modulus, and the one-dimensional static yield stress were calculated. The elastic wave velocity from shock loading agrees favorably with the ultrasonic longitudinal wave velocity. Author (GRA)

N77-22543# Dayton Univ. Research Inst., Ohio.
RESPONSE OF MATERIALS TO IMPULSIVE LOADING Final Report, Dec. 1972 - Nov. 1975
John P. Barber and Henry R. Taylor Mar. 1976 23 p refs
(Contract F33615-73-C-5027; AF Proj. 7351)
(AD-A033059; AFML-TR-76-17) Avail: NTIS HC A02/MF A01 CSCL 11/4

This report describes work conducted on the response of composite materials to foreign object damage. The damage inflicted to both metal matrix and resin matrix composites was investigated by measuring the post impact residual mechanical properties of selected materials. Specimens were mounted as simply supported cantilevered beams and impacted with steel or rubber spheres. The residual tensile and fatigue strength of the material was then determined. The impact resistance of the composites investigated was shown to be much lower than that for titanium. The important mechanisms of material damage were identified and described in terms of a fracture mechanics based model. Author (GRA)

N77-22544# Utah Dept. of Transportation, Salt Lake City. Research and Development Unit.
CHARACTERISTICS OF ASPHALTS AS RELATED TO THE PERFORMANCE OF FLEXIBLE PAVEMENTS Final Report
Douglas I. Anderson Jun. 1976 84 p refs Sponsored in part by the DOT and FHA
(PB-262105/0; Utah-RR-500-925-B; FHWA/RD-76-S0541)
Avail: NTIS HC A05/MF A01 CSCL 13C

Pavement cracking and related distress are the major problems with Utah highways. This study was initiated to isolate the causes and propose solutions to this problem. The most significant factor influencing transverse cracking was found to be the source of asphalt crude. This difference in asphalt performance was found to be related to the parameters temperature susceptibility, force ductility, ductility, aging index, chemical composition, and cannon cone viscosity. The viscosity and penetration grading methods were found to be inadequate in controlling pavement cracking. The high level of air voids content was found to cause a more rapid hardening of the asphalt binder than the low level of air voids. GRA

N77-22545# Illinois Univ., Chicago. Dept. of Materials Engineering.
FERROCEMENT IN BENDING. PART 1: STATIC NONLINEAR ANALYSIS Progress Report
P. Balaguru, A. E. Naaman, and S. P. Shah Aug. 1976 154 p refs

(Grant NSF ENG-74-20829)
(PB-262155/5; Rept-76-2-Pt-1) Avail: NTIS HC A08/MF A01 CSCL 13M

Experiments were carried out to determine the stress-strain curves of mortar and different steel meshes; and to find the load-deflection curves, crack distribution, and crack width for ferrocement beams reinforced with varying volumes of welded and woven steel meshes. An analytical model was formulated to analyze and predict the nonlinear load-deflection behavior of ferrocement beams from the measured stress-strain curves. The model satisfactorily predicts the load-deflection curves of ferrocement and reinforced concrete beams. Based on the model, a simple relationship is proposed to predict the crack width versus steel stress for ferrocement beams. GRA

N77-22546# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.

TRANSIENT RESPONSE OF A CANTILEVERED PLATE TO IMPACT USING HOLOGRAPHIC INTERFEROMETRY AND FINITE ELEMENT TECHNIQUES Final Report, 1 Jan. - 1 Aug. 1976

James C. MacBain Aug. 1976 71 p refs
(AD-A031609; AFAPL-TR-76-56) Avail: NTIS HC A04/MF A01 CSCL 20/11

This report covers work carried out at AFAPL's Turbo Structures Research Laboratory (TSRL) on the transient structural response of an isotropic cantilevered plate subjected to normal impact by a ballistic pendulum. The program was a combined experimental/analytical effort. The experimental portion utilized a pulsed ruby laser to obtain holographic interferograms of the plate's deformation following impact. The analytical portion of the work consisted of mathematically modelling the plate using finite element techniques and studying the model's response to impact using the general purpose finite element program, NASTRAN. Author (GRA)

N77-22547# Federal Highway Administration, Arlington, Va. Demonstration Projects Div.

DEMONSTRATION PROJECT NO. 10, IMPROVED SKID RESISTANT PAVEMENTS Final Report

Raymond F. Pelletier Feb. 1976 52 p
(PB-261888/2; FHWA-DP-10) Avail: NTIS HC A04/MF A01 CSCL 13B

As part of the Federal Highway Administration (FHWA) Demonstration Projects Program, Demonstration Project No. 10, Improved Skid Resistant Pavements, was intended to demonstrate the effectiveness of open-graded asphalt friction courses (often termed plant-mix seals) and to assist those states interested in trying this skid resistant pavement overlay for the first time. GRA

N77-22548# Ballistic Research Labs., Aberdeen Proving Ground, Md.

A FAMILY OF FINITE ELEMENT CODES FOR THE ANALYSIS OF GENERALIZED ORTHOTROPIC AXISYMMETRIC BODIES

William H. Drysdale Oct. 1976 23 p refs
(AD-A032335; BRL-MR-2697) Avail: NTIS HC A02/MF A01 CSCL 11/4

The SAGA family of finite element codes capable of analyzing axisymmetric bodies of filament wound composite materials (including torsional loads) is described. Changes made to the contractor supplied listings are discussed and the application of the codes to several example problems is presented. GRA

N77-22549# Weidlinger Associates, New York.

DYNAMIC RESPONSE OF AN AXISYMMETRIC LINED CYLINDRICAL CAVITY OF FINITE LENGTH IN A BILINEAR MATERIAL Final Report

A. T. Matthews and H. H. Bleich Apr. 1976 68 p refs
(Contract DASA01-71-C-0098; DNA Proj. NWED-QAXSC061)
(AD-A031760; DNA-3997F) Avail: NTIS HC A04/MF A01 CSCL 19/4

A pressure pulse p(theta) is applied to the interior of an axisymmetric, lined cylindrical cavity of finite length, embedded in a bilinear type dissipative material. The cavity lining is a structure composed of a thin, axisymmetric cylindrical shell with bending stiffness, welded to a flat circular plate at the bottom. The response of the structure is found from a variational procedure on the energy expressions in finite difference form. The response of the dissipative material is found from a pseudo-characteristic scheme combined with a fractional step method (and given the name PC scheme). Results are presented and compared with results from a finite element scheme applied to the same configuration. These comparisons illustrate the use of this PC scheme code as a check solution for a large computer code such as the finite element one. GRA

N77-22550# Rockwell International Corp., Thousand Oaks, Calif. Science Center.

IMPACT DAMAGE IN BRITTLE MATERIALS IN THE PLASTIC RESPONSE REGIME Technical Report, 1 Jan. - 30 Oct. 1976

A. G. Evans, M. E. Gulden (Solar, San Diego, Calif.), G. E. Eggum (Calif. Res. and Technol., Inc.), and M. Rosenblatt 30 Oct. 1976 55 p refs
(Contract N00014-75-C-0669)
(AD-A031407; SC5023.9TR) Avail: NTIS HC A04/MF A01 CSCL 19/4

The impact damage created in the plastic response regime has been characterized in terms of the surface extension and the penetration of the fractures. A numerical dynamic analysis has been performed (of a typical impact within this regime) to indicate some of the principal characteristics of the contact behavior and the stress field. The damage has then been analyzed - using simplified postulates based on key features of the impact dynamics and the quasi-static indentation fracture - which has enabled the primary material and target parameters affecting the impact fracture to be identified. Thereafter, some implications for strength degradation and erosion have been discussed. Author (GRA)

N77-22551# Army Materiel Systems Analysis Activity, Aberdeen Proving Ground, Md.

A WEIBULL MODEL TO ESTIMATE RESIDUAL AND CRITICAL VELOCITIES FOR TARGET PENETRATIONS

D. Clark, L. Crow, and J. Sperrazza Jul. 1976 56 p refs
(AD-A031640; AMSSA-TR-170) Avail: NTIS HC A04/MF A01 CSCL 19/4

A procedure based on the versatile three-parameter Weibull Distribution function is used to estimate the relationship between the striking velocity and the residual velocity of a projectile penetrating some target material. Nonlinear estimation procedures are used to fit this model to experimental data. A comparison of this model and a hyperbolic model using typical data is presented. A FORTRAN program for implementation of the techniques is included. Author (GRA)

N77-22552# Battelle Columbus Labs., Ohio.

THREE-DIMENSIONAL FINITE ELEMENT STRESS ANALYSIS OF LAMINATED PLATES CONTAINING A CIRCULAR HOLE Final Report, 15 Jan. - 15 Jul. 1975

Edmund F. Rybicki and David W. Schmueser Wright-Patterson AFB, Ohio AFML Aug. 1976 55 p refs
(Contract F33615-74-C-5096)
(AD-A032428; AFML-TR-76-92) Avail: NTIS HC A04/MF A01 CSCL 11/4

One of the modes of failure of laminated plates is delamination which initiates at a free edge. Experimental results and theoretical stress analyses found in the literature point to the interlaminar normal stress as a governing factor for this mode of failure. In this report, the stress behavior around a circular hole in a laminated plate is investigated using a three-dimensional finite element stress analysis. Attention is focused on the interlaminar normal stress distribution around the edge of the circular hole. Graphite epoxy laminates were modeled. Two types of loadings were considered. One was a uniform stress applied distant to the hole. The other was a uniform temperature change to represent the thermal portion of the laminate fabrication process. Other laminates of the type (0/90)s, (90/0)s, (0/2- 45/0)s, and (-45/02/0)s were considered. In total, results for over thirty laminates are presented. Most of the results are in tabular form. GRA

N77-22553# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
INTEGRATION OF MIT STUDIES ON PREDICTION AND CONTROL OF DISTORTION IN WELDED ALUMINUM STRUCTURES
Vassilios Papazoglou and Koichi Masubuchi 20 Sep. 1976 172 p refs
(Contract N00014-75-C-0469)
(AD-A033490; TR-1) Avail: NTIS HC A08/MF A01 CSCL 13/8

This report covers the development of analytical means for predicting and controlling weld distortion of welded aluminum structures. The report presents basic background information and covers the present state-of-the-art by integrating results obtained recently at M.I.T. Distortion in welded structures is caused by three fundamental dimensional changes, namely transverse shrinkage, longitudinal shrinkage and angular change. During the fabrication of actual structures, such as ships, airplanes and buildings which have various types of joints, these dimensional changes are combined. Therefore, shrinkage distortion that occurs in structures can be extremely complex. GRA

N77-22554# Advisory Group for Aerospace Research and Development, Paris (France).
FRACTURE MECHANICS DESIGN METHODOLOGY
Feb. 1977 271 p refs Partly in ENGLISH and FRENCH Presented at the 43d Meeting of the AGARD Struct. and Mater. Panel, London, 28-29 Sep. 1976
(AGARD-CP-221; ISBN-92-835-1090-X) Avail: NTIS HC A12/MF A01

Papers concerning the application of fracture mechanics to the design of aircraft are presented. Several papers deal with analyses for obtaining safe-life fail-safe aircraft structures. Design concepts are highlighted for achieving damage-tolerant structures. For individual titles, see N77-22555 through N77-22567.

N77-22555# Hawker Siddeley Aviation Ltd., London (England).
PRACTICAL APPLICATIONS OF FRACTURE MECHANICS TECHNIQUES TO AIRCRAFT STRUCTURAL PROBLEMS
W. G. Heath, L. F. Nicholls (British Aircraft Corp., London), and W. T. Kirkby (RAE, Farnborough) *In* AGARD Fracture Mech. Design Methodology Feb. 1977 22 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Experience gained in the UK in the application of fracture mechanics techniques to problems arising in the design, testing and operation of aircraft is outlined. Design examples are taken from studies of crack behavior in stiffened wing panels and also from pressure cabin design, including areas subject to combined mechanical and thermal stresses. Problems of testing are illustrated by reference to the use of COD, and other measurements, in residual strength tests to predict approach to unstable crack growth. Test data are given which illustrate scatter in crack growth in stiffened panels. In addition, the nature of the difficulties that have been encountered in applying fracture mechanics analysis to failures arising in aircraft in service is discussed.
Author

N77-22556# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
CRACK PROPAGATION AND RESIDUAL STATIC STRENGTH OF TYPICAL AIRCRAFT FORGINGS
Walter Schuetz *In* AGARD Fracture Mech. Design Methodology Feb. 1977 18 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

A test program was carried out using nose landing gear struts of 7075-T6, manufactured to the same drawings, but forged by several forges in different countries. Cracks were introduced in various sections of the forgings and crack propagation and residual static strength determined by test and compared with calculations. It was not possible to predict residual static strength with any accuracy even if an ASTM-CT specimen was taken out of the same forging near the failure location. Crack propagation under two realistic load sequences was highly irregular and could not be correctly predicted using the Willenborg retardation model. Also, scatter of the above properties was much larger than for the sheet and plate specimens normally used for such tests.
Author

N77-22557# General Dynamics/Fort Worth, Tex.
APPLICATION OF FRACTURE MECHANICS TO THE F-111 AIRPLANE
W. D. Buntin *In* AGARD Fracture Mech. Design Methodology Feb. 1977 12 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Safe service operations of critical steel components in the F-111 aircraft are assured by analyses and tests developed using principles of fracture mechanics. A unique flaw in a major fitting which forms the inboard section of the wing caused the loss of an airplane in flight. Subsequent analytical and experimental investigations are described which thoroughly investigated the fracture characteristics of all critical steel components in the airframe. Fracture analysis tools were developed and used as essential elements in interpreting experimental data and in describing the damage tolerance of the F-111 fleet. The methodology which was evolved is compared with current airplane damage tolerance requirements.
Author

N77-22558# Northrop Corp., Hawthorne, Calif. F-5 Technology Dept.
NORTHROP/UNITED STATES AIR FORCE DURABILITY AND DAMAGE-TOLERANCE ASSESSMENT OF THE F-5E/F AIRCRAFT
S. R. Murnane, T. D. Stronge, and O. B. Davenport (Aeronautical Systems Div., Wright-Patterson AFB, Ohio) *In* AGARD Fracture Mech. Design Methodology Feb. 1977 33 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Fatigue test failures experienced during a complete airframe flight-by-flight fatigue test are reviewed, including the application of fracture mechanics employed during resolution of these failures. Damage-tolerance analyses and specimen tests for other primary structure are discussed. State-of-the-art analytical crack growth rate predictions for flight-by-flight spectra are compared with specimen test results. Compliance of the F-5E/F airframe structure with the USAF damage-tolerance requirements is discussed, along with recommendations for the application of fracture mechanics to future aircraft design.
Author

N77-22559# National Aerospace Lab., Amsterdam (Netherlands).
APPLICATION OF FRACTURE MECHANICS IN DESIGNING BUILT-UP SHEET STRUCTURES
H. Vlieger *In* AGARD Fracture Mech. Design Methodology Feb. 1977 18 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Different analyses that are relevant to the design of a fail-safe aircraft structure are discussed: the static strength, the crack initiation and propagation and the residual strength analyses. The application of fracture mechanics in the crack propagation and residual strength analyses is given particular attention. Theoretical results of an investigation carried out in this field and verification of these results by experiments are shown. Finally, some guidelines for aircraft structural applications are presented.
Author

N77-22560# Aeronautica Macchi S. p. A., Varese (Italy).
COMPARATIVE EXPERIMENTAL OBSERVATIONS AND THEORETICAL ANALYSIS OF THE PROPAGATION OF FATIGUE CRACKS
G. L. DeOtto *In* AGARD Fracture Mech. Design Methodology Feb. 1977 21 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

The fracture sections of two primary structural elements that failed during the fatigue tests on the complete aircraft are examined. The building-up and propagation of the cracks, the interaction effect between the various cracks, the validity of the nondestructive inspection methods and the importance of the test load spectrum are shown by a microfractography examination of the same sections. The assumptions on fatigue striations are verified and crack propagation experimental curves determined for an appropriate selection of the inspection intervals. The

experimental propagation curves are compared to the theoretical curves calculated by the equation of Forman. Author

N77-22561# Pisa Univ. (Italy).
FATIGUE BEHAVIOUR OF CRACKED STIFFENED PANELS
A. Salvetti *In* AGARD Fracture Mech. Design Methodology Feb. 1977 22 p refs Sponsored in part by US Army (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Methods of fail-safe design of aircraft structures were studied. Two main objectives were the development of methodologies to compute the crack growth under fatigue loading in stiffened structures and the determination of minimum weight design methodologies suitable for fail-safe structures. The K-rate relationship in stiffened structures was evaluated, and the methodologies to correlate the stringer fatigue failures with the crack length in the sheet cover were investigated. Results on such topics based on a large set of experimental and theoretical data on cracked stiffened structures are presented. The problem of designing minimum weight panels taking into account the fail-safe requirement was undertaken with reference to the wing lower surface structure. Using mathematical programming, the optimum distribution of resisting material between sheet cover and stringers was sought, taking into account not only the buckling phenomena connected with negative load factor flight conditions, but also the fail-safe requirement of the fail-safe load for an assigned inspection interval, with given initial damage and load spectrum. Author

N77-22562# National Aerospace Lab., Amsterdam (Netherlands).
CALCULATION OF STRESS INTENSITY FACTORS FOR CORNER CRACKING IN A LUG
R. J. H. Wanhill and C. J. Lof *In* AGARD Fracture Mech. Design Methodology Feb. 1977 8 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

A three-dimensional finite element analysis of corner flaws in aircraft lugs was conducted. The results were compared with experimental calibration of the effective stress intensity factor and previously suggested analytical solutions. Author

N77-22563# Societe Nationale Industrielle Aerospatiale, Paris (France). Lab. Central.
APPLICATION OF FRACTURE MECHANICS TO THE SELECTION OF ALUMINUM ALLOYS, PART 1 [APPLICATION DE LA MECANIQUE DE LA RUPTURE A LA SELECTION DES ALLIAGES D'ALUMINIUM, 1ERE PARTIE]
Jacques Odorico *In* AGARD Fracture Mech. Design Methodology Feb. 1977 7 p In FRENCH (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

The essential properties to guarantee the safety, availability and longevity of aircraft structures are considered. These properties consist of some of the following: (1) residual static resistance of pre-cracked test material; (2) sensitivity to corrosion under tension; (3) resistance to fatigue; and (4) protection against corrosion for the maintenance of the structures. Results acquired for these different properties are presented. Transl. by B.B.

N77-22564# Societe Nationale Industrielle Aerospatiale, Paris (France). Lab. Central.
APPLICATION OF FRACTURE MECHANICS TO THE SELECTION OF ALUMINUM ALLOYS. PART 2: RESULTS [APPLICATION DE LA MECANIQUE DE LA RUPTURE A LA SELECTION DES ALLIAGES D'ALUMINIUM, 2EME PARTIE: RESULTATS]
Claude Bathias *In* AGARD Fracture Mech. Design Methodology Feb. 1977 13 p refs In FRENCH (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

Three approaches in the application of fracture mechanics to the selection of aluminum alloys are presented, and their behavior is determined. Principal results are shown and discussed along with various means of investigation. Transl. by B.B.

N77-22565# Vereinigte Flugtechnische Werke-Fokker G.m.b.H., Bremen (West Germany).
INFLUENCE OF ENVIRONMENT AND PRODUCTION PROCESSES ON THE CRACK PROPAGATION BEHAVIOR OF UNSTIFFENED SHEET
K. H. Rendigs *In* AGARD Fracture Mech. Design Methodology Feb. 1977 14 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

The fracture behavior of unstiffened sheet under environmental and production process influences was investigated to give information on how far fracture toughness properties established under normal laboratory conditions can be transferred into practice. Crack propagation properties, K sub c values and residual strength were established on clad 2.0 mm thick sheet of aluminum alloy 2024 in naturally aged condition at a stress level of 88.3 + or - 39.2 N/sq m and under environmental and production process influences. The environmental influences examined were normal laboratory conditions and continual wetting with artificial sea water. The production process influences examined were: (1) stretching with a total amount of stretch forming of 13 and 16 percent respectively; (2) a bonding cycle simulated in the delivered condition; and (3) stretching with a total amount of stretch forming of 13 percent with following bonding cycle. Author

N77-22566# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
PROOF-LOAD TESTING ON 300 M STEEL
Wolfgang Geier and Karl O. Sippel *In* AGARD Fracture Mech. Design Methodology Feb. 1977 12 p refs (For primary document see N77-22554 13-39)
Avail: NTIS HC A12/MF A01

As a result of the fundamental considerations made on the Proof-Load Procedure, general conditions for its basic applicability were defined. It was established that the procedure is sufficiently safe for use if the maximum operational load is limited or the safe crack growth interval is considered to be a statistical value. The test results proved that the safe crack growth interval can be determined theoretically. The examination of the specific proof-load parameters provided new information on the effects and influence of the test parameters on crack propagation and residual strength. The rate of crack propagation decreases with increasing proof-load in relation to the operational load and with the proof-load interval becoming smaller. The proof-load conditions being constant, the permissible interval for the transport aircraft load spectrum is greater than that for the combat aircraft load spectrum. Author

N77-22567# Air Force Systems Command, Wright-Patterson AFB, Ohio.
DAMAGE TOLERANCE AND DURABILITY ASSESSMENTS OF UNITED STATES AIR FORCE AIRCRAFT
M. D. Coffin, C. F. Tiffany, and R. Bader *In* AGARD Fracture Mech. Design Methodology Feb. 1977 21 p ref (For primary document see N77-22554 13-39)
Avail: NTIS HC A02/MF A01

A program to conduct damage tolerance and durability assessments of 'in-service' aircraft to assure structural safety and economic life management is discussed. The F-4C/D assessment serves as a classic example to illustrate the objectives, the approach, and the results desired. The general methodology associated with the accomplishment of the technical tasks is presented and discussed. The modification and inspection program resulting from this assessment is described. Author

N77-22568# Advisory Group for Aerospace Research and Development, Paris (France).
SPECIALISTS' MEETING ON ACOUSTIC FATIGUE REVIEW
1976 82 p In ENGLISH; partly in FRENCH Presented at the 43d meeting of the Struct. and Mater. Panel, London, 30 Sep. 1976
(AGARD-CP-222) Avail: NTIS HC A05/MF A01

Methods and facilities for investigating acoustic fatigue in aircraft construction materials in NATO countries are summarized. For individual titles, see N77-22569 through N77-22573.

N77-22569# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (West Germany).
REVIEW OF ACOUSTIC FATIGUE ACTIVITIES IN GERMANY

Gerhard Bayerdoerfer *In* AGARD Specialists' Meeting on Acoustic Fatigue Rev. 1976 10 p refs (For primary document see N77-22568 13-39)
Avail: NTIS HC A05/MF A01

Acoustic fatigue tests were carried out on the German-manufactured parts of the European Airbus A 300 B, the shorthaul transport VFW 614, the vertical takeoff VAK 191, the NRCA, and the Alpha-Jet aircraft. Besides this project-oriented work, studies of a more fundamental nature were concerned with technology. In addition, a number of qualification tests were carried out on spacecraft such as Helios, Cos B, Meteosat OTS, ISEE-B and Marots. Author

N77-22570# Aeritalia, Turin (Italy).
REVIEW OF ACOUSTIC FATIGUE ACTIVITIES IN ITALY
G. Incarbone *In* AGARD Specialists' Meeting on Acoustic Fatigue Rev. 1976 3 p refs (For primary document see N77-22568 13-39)
Avail: NTIS HC A05/MF A01

Theoretical and experimental research works were cooperatively carried out in Italy on fatigue phenomena and behavior of aeronautical structures under acoustic loads, and research on fracture mechanics of pressurized space structures subjected to acoustic fatigue. In addition, some indications for new work in acoustic fatigue are given. Author

N77-22571# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
REVIEW OF ACOUSTIC FATIGUE ACTIVITIES IN THE USA
A. W. Kolb *In* AGARD Specialists' Meeting on Acoustic Fatigue Rev. 1976 15 p refs (For primary document see N77-22568 13-39)
Avail: NTIS HC A05/MF A01

Recent and current sonic fatigue research and development programs are reviewed. The areas discussed include load criteria, development of long life sonic fatigue design criteria for weldbonded and bonded structures, composites and honeycomb panels for high temperature application. Recent advances and planned programs in testing techniques are also presented. These include the determination of structural mode shapes by computer techniques and development of a programmable high cycle fatigue testing system designed to obtain coupon specimen data to 10 to the ninth power cycles or above. Finally, proposed work is presented. Publications concerning the program discussed are listed for further reference. Author

N77-22572# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
EXPERIMENTAL SOLUTIONS OF ACOUSTIC FATIGUE PROBLEMS [SOLUTION EXPERIMENTALE DE PROBLEMES DE FATIGUE ACOUSTIQUE]
R. Loubet and J. Gay *In* AGARD Specialists' Meeting on Acoustic Fatigue Rev. 1976 15 p In FRENCH (For primary document see N77-22568 13-39)
Avail: NTIS HC A05/MF A01

Resonance under sinusoidal excitation and dynamic response and durability under hazardous excitation were measured for carbon and boron reinforced materials. Results were compared with the behavior of light alloy and steel samples under the same conditions. Measurements obtained during a proof test on a carbon fiber rudder are analyzed and used to estimate its behavior at sonic fatigue. Damages to the fairings of an operating aircraft rudder servomechanism are investigated. Replacement of the framework is defined and justified. Transl. by A.R.H.

N77-22573# British Aircraft Corp., Filton (England). Commercial Aircraft Div.
REVIEW OF ACOUSTIC FATIGUE ACTIVITIES IN THE UNITED KINGDOM
D. C. G. Eaton *In* AGARD Specialists' Meeting on Acoustic Fatigue Rev. 1976 31 p refs (For primary document see N77-22568 13-39)
Avail: NTIS HC A05/MF A01

Typical airframe acoustic fatigue experience associated with UK project activity is presented. Problems associated with mounting of equipment and systems are considered. An account is given of systematic studies of noise induced crack propagation behavior in light alloy machined structure and related sub-structure. Examples are presented of R and D activities and findings in the airframe, space and nuclear engineering sectors. Author

42 GEOSCIENCES (GENERAL)

N77-22574*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JPL FIELD MEASUREMENTS AT THE FINNEY COUNTY, KANSAS, TEST SITE, OCTOBER 1976: METEOROLOGICAL VARIABLES, SURFACE REFLECTIVITY, SURFACE AND SUBSURFACE TEMPERATURES
Anne B. Kahle, John Schieldge, and Helen N. Paley 1 Feb. 1977 62 p refs
(Contract NAS7-100)
(NASA-CR-152675; JPL-Publ-77-1) Avail: NTIS HC A04/MF A01 CSCL 08F

Data collected at the Finney County, Kansas test site as part of the Joint Soil Moisture Experiment (JSME) are presented here, prior to analysis, to provide all JSME investigators with an immediate source of primary information. The ground-truth measurements were taken to verify and complement soil moisture data taken by microwave and infrared sensors during aircraft overflights. Measurements were made of meteorological variables (air speed, temperature, relative humidity, and rainfall), surface reflectivity, and temperatures at and below the surface. Author

N77-22575# Addis Translations International,, Portola Valley, Calif.
SYSTEMS ANALYSIS OF THE PROBLEM OF LARGESCALE OSCILLATIONS OF THE CLIMATE AND GLACIATION OF THE EARTH
V. Ya. Sergin and S. Ya Sergin 1976 60 p refs Transl. into ENGLISH from the book "Modelirovanie planetarnoi sistemy ledniki-okean-atmosfera", Vladivostok, USSR Acad. of Sciences, 1976 p 5-51 Sponsored by ERDA
(UCRL-Trans-11183; LLL-02240) Avail: NTIS HC A04/MF A01

The basis for this work was the construction of a thermodynamic model of the glaciers-ocean-atmosphere system that provides for an individual description of the Northern and Southern hemispheres and of the relations between them. Construction of the model becomes practicable only after the introduction of a number of simplifications, of which the transition from partial derivative equations to ordinary differential equations is the most significant. This transition is nontrivial and requires the introduction of special methods to describe the system. The elucidation of the thermodynamic mechanism of largescale fluctuations of the earth's climate and glaciation therefore can contribute to a better understanding of the causes of climatic changes. ERA

N77-22576# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
COLLECTED REPRINTS: 1974 - 1975, WAVE PROPAGATION LABORATORY Technical Report, 1 Jan. 1974 - 31 Dec. 1975
Jul. 1976 613 p refs
(PB-262132/4; NOAA-76111050) Avail: NTIS HC A99/MF A01 CSCL 04A

The reprints in this volume are compiled under the following subjects: acoustic and gravity wave propagation; wave propagation at optical frequencies; remote sensing concepts, geophysical studies; and development of instruments and techniques. GRA

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography*.

N77-22577*# Atomic Energy Commission, Dacca (Bangladesh).
INVESTIGATIONS USING DATA FROM LANDSAT-2 Quarterly Report, Oct. - Dec. 1976
Anwar Hossain, Principal Investigator Feb. 1977 4 p refs Sponsored by NASA ERTS
(E77-10138; NASA-CR-152632) Avail: NTIS HC A02/MF A01 CSCL 05B

The author has identified the following significant results. New lands for forestation were set aside in the coastal area of Bangladesh, based on LANDSAT mosaics (Chittagong - 195,000 acres, Noakhali - 450,000 acres, Barisal - 360,000 acres, and Patuakhali - 225,000 acres). LANDSAT imageries were used for identification of drainage patterns in both the old and and new Comilla district.

N77-22578*# Colorado School of Mines, Golden.
GROUND WATER RECHARGE TO THE AQUIFERS OF NORTHERN SAN LUIS VALLEY, COLORADO: A REMOTE SENSING INVESTIGATION
Keenan Lee, Principal Investigator and David Huntley Dec. 1976 313 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(Grant NGL-06-001-015)
(E77-10149; NASA-CR-152649; Rept-76-3) Avail: NTIS HC A14/MF A01 CSCL 08H

The author has identified the following significant results. Ground water recharge to the aquifers of San Luis Valley west of San Luis Creek was primarily from ground water flow in the volcanic aquifers of the San Juan Mountains. The high permeability and anisotropic nature of the volcanic rocks resulted in very little contrast in flow conditions between the San Juan Mountains and San Luis Valley. Ground water recharge to aquifers of eastern San Luis Valley was primarily from stream seepage into the upper reaches of the alluvial fans at the base of the Sangre de Cristo Mountains. The use of photography and thermal infrared imagery resulted in a savings of time and increase in accuracy in regional hydrogeologic studies. Volcanic rocks exhibited the same spectral reflectance curve as sedimentary rocks, with only the absolute magnitude of reflectance varying. Both saline soils and vegetation were used to estimate general ground water depths.

N77-22579*# Bureau of Land Management, Denver, Colo.
A LANDSAT STUDY OF EPHEMERAL AND PERENNIAL RANGELAND VEGETATION AND SOILS Final Report, 1 Mar. 1975 - 1 Dec. 1976
R. Gordon Bentley, Jr., Principal Investigator, Bette C. Salmon-Drexler, William J. Bonner, and Robert K. Vincent 1 Dec. 1976 244 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(NASA Order S-53966-A)
(E77-10150; NASA-CR-152650; YA-300-1700-1012) Avail: NTIS HC A11/MF A01 CSCL 08F

The author has identified the following significant results. Several methods of computer processing were applied to LANDSAT data for mapping vegetation characteristics of perennial rangeland in Montana and ephemeral rangeland in Arizona. The choice of optimal processing technique was dependent on prescribed mapping and site condition. Single channel level slicing and ratioing of channels were used for simple enhancement. Predictive models for mapping percent vegetation cover based on data from field spectra and LANDSAT data were generated by multiple linear regression of six unique LANDSAT spectral ratios. Ratio gating logic and maximum likelihood classification were applied successfully to recognize plant communities in Montana. Maximum likelihood classification did little to improve recognition of terrain features when compared to a single channel density slice in sparsely vegetated Arizona. LANDSAT was found to be more sensitive to differences between plant communities based on percentages of vigorous vegetation than to actual physical or spectral differences among plant species.

N77-22580*# Centre d'Etude Spatiale des Rayonnements, Toulouse (France).
AGRESTE PROGRAMME. PART 2: FRENCH TEST SITES Progress Report, Jul. - Dec. 1976
G. Flouzat, Principal Investigator, P. Cassirame, and J. Quach Dec. 1976 41 p refs Sponsored by NASA Original contains imagery. Orginal photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 ERTS
(E77-10151; NASA-CR-152651) Avail: NTIS HC A03/MF A01 CSCL 05B

The author has identified the following significant results. Results show that the available timber is decreasing after 1980. This comes from the corn extension program. Timber volume evaluations are given by biometrical connections between the mean surface of poplar crowns in a plantation and the mean circumference of the same trees taken at 1.30 m. LANDSAT imagery was found sufficient for large field discrimination, but small parcels like market-gardens were not discernible. Discrete operators were used to smooth, sharpen, or detect edges of digital pictures.

N77-22581*# Environmental and Regional Research Associates, Inc., Johnson City, Tenn.
PHOTOMORPHIC ANALYSIS TECHNIQUES: AN INTERIM SPATIAL ANALYSIS USING SATELLITE REMOTE SENSOR IMAGERY AND HISTORICAL DATA Final Report
Harold R. Keuper, Robert W. Peplies, and Robert P. Gillooly Jan. 1977 268 p refs
(Contract NAS8-31329)
(NASA-CR-150227; ERRA-74-17(R)-Y) Avail: NTIS HC A12/MF A01 CSCL 05B

The use of machine scanning and/or computer-based techniques to provide greater objectivity in the photomorphic approach was investigated. Photomorphic analysis and its application in regional planning are discussed. Topics included: delineation of photomorphic regions; inadequacies of existing classification systems; tonal and textural characteristics and signature analysis techniques; pattern recognition and Fourier transform analysis; and optical experiments. A bibliography is included. Author

N77-22582*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TRANSFORMATIONS FROM AN OBLATE SPHEROID TO A PLANE AND VICE VERSA: THE EQUATIONS USED IN THE CARTOGRAPHIC PROJECTION PROGRAM MAP2
Denis A. Elliott and Arnold A. Schwartz 15 Feb. 1977 29 p refs
(Contract NAS7-100)
(NASA-CR-152679; JPL-Publ-77-7) Avail: NTIS HC A03/MF A01 CSCL 08B

The relationships between the coordinates of a point on the surface on an oblate spheroid and the coordinates of the projection of that point in several common map projections are discussed. Because several of the projections are conformal, the theory of conformally mapping an oblate spheroid to the plane is summarized. For each projection considered, the equations which map the spheroid to the plane and their inverses are given. Author

N77-22583*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
BRAVO ECONOMIC STUDY OF LANDSAT FOLLOW-ON Final Report
Ernest I. Pritchard, Richard T. Blake, James A. Plough, Orin J. Mead, and John J. Dawson Jan. 1977 56 p refs
(Contract NAS5-23592)
(NASA-CR-152497; ATR-76(7597)-1) Avail: NTIS HC A04/MF A01 CSCL 05B

The LANDSAT Follow-On satellite consists of two major systems: the instrument module and the Multi-Mission Modular Spacecraft (MMS). The instrument module contains the thematic mapper and the five-band multispectral scanner instruments. The instrument module also includes the solar array, the tracking and data relay satellite (TDRS) antenna, and the wideband data module. The MMS contains the modularized and standardized power, propulsion, attitude control, and command and data handling subsystems. The Shuttle will be supporting the LANDSAT Follow-On system. The LANDSAT Follow-On Project plans two Delta 3910 launches. The first is scheduled for 1981; the second Delta launch will occur as needed to keep one satellite operational

on orbit. The second satellite will be ready six months after the first. It could be launched any time after that. Shuttle support of the system could begin in early 1983 but would be scheduled to start after the second Delta launch. Author

N77-22584*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
GEOLOGICAL APPLICATIONS OF NIMBUS RADIATION DATA IN THE MIDDLE EAST
Lewis J. Allison Washington Apr. 1977 81 p refs
(NASA-TN-D-8469; G7702-F6) Avail: NTIS HC A05/MF A01 CSCL 08G

Large plateaus of Eocene limestone and exposed limestone escarpments, in Egypt and Saudi Arabia, respectively, were indicated by cool brightness temperatures recorded by the Nimbus-5 electrically scanning microwave radiometer (ESMR), over a 2-year period. Nubian sandstone, desert eolian sand, and igneous-metamorphic rock of the Pliocene, Miocene, Oligocene, and Cretaceous periods were differentiated from these limestone areas by warm T sub B values. These brightness temperature differences are a result of seasonal in-situ ground temperatures and differential emissivity of limestone and sand, sandstone and granite, whose dielectric constants are 6 to 8.9 and 2.9 and 4.2 to 5.3, respectively, at 19.35 GHz. Author

N77-22585# Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering.
OPTIMAL DESIGN AND OPERATION OF MULTIRESERVOIR SYSTEMS. VOLUME 1: EXPLICITLY STOCHASTIC MODELS
Final Report
Mark H. Houck and Jared L. Cohon Jun. 1976 208 p refs 2 Vol.
(Grant NSF GK-42123)
(PB-262017/7; SAE-PDM-76-01-Vol-1) Avail: NTIS HC A10/MF A01 CSCL 13B

Optimization models offer a valuable tool to the river basin planner. Two models - the Linear Decision Rule (LDR) and the Sequential Explicit Stochastic Linear Programming (SESLP) models - are of particular importance because they can consider in a comprehensive format the issues of locating, sizing, and operating multiple-use, multiple-reservoir systems. These two models are restructured and extended. A reformulation of the SESLP models results in a substantial reduction in computational burden so that the models are now usable for realistic systems. The LDR model is extended to explicitly include economic benefits or losses. Energy generation is also considered for the first time in the LDR model and a new perspective on the water supply potential of a reservoir system is given. GRA

N77-22586# Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering.
OPTIMAL DESIGN AND OPERATION OF MULTI-RESERVOIR SYSTEMS. VOLUME 2: ALTERNATIVE OPTIMIZATION MODELS OF THE LEHIGH RIVER BASIN
Final Report
Mark H. Houck and Jared L. Cohon Jun. 1976 162 p refs 2 Vol.
(Grant NSF GK-42123)
(PB-262018/5; SAE-PDM-76-02-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 13B

Many optimization models for reservoir design and/or operation were suggested in the literature. In this report, many of these models are formulated for the analysis of the Lehigh River Basin. Tentative conclusions on the relative strengths and weaknesses of the models are drawn. GRA

N77-22587# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
THE INFLUENCE OF LATERAL MASS EFFLUX ON FREE CONVECTION BOUNDARY LAYERS IN A SATURATED POROUS MEDIUM
Ping Cheng 28 Apr. 1976 23 p refs
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261558/1; HGP-TR-13; NSF/RA-760372) Avail: NTIS HC A02/MF A01 CSCL 08I

The effects of lateral mass efflux with prescribed temperature and velocity on vertical free convection boundary layers in a saturated porous medium at high Rayleigh numbers are studied. Within the framework of boundary layer theory, similarity solutions are obtained for the special case where the prescribed temperature and velocity of the fluid vary as (x to the lambda power) and (x to the power((lambda-1)/2)) respectively. The effects of mass efflux on surface heat transfer rate and boundary layer thickness are shown. Application to warm water discharge along a well or fissure to an aquifer of infinite extent is discussed. GRA

N77-22588# Texas A&M Univ., College Station. Water Resources Inst.
ENVIRONMENTAL EVALUATION OF WATER RESOURCES DEVELOPMENT
Wesley P. James, Calvin E. Woods, and Robert E. Blanz Sep. 1976 231 p refs
(Contracts DI-14-31-0001-5044; DI-14-31-0001-6045)
(PB-262011/0; TR-76; W77-02828; OWRT-A-028-TEX(1)) Avail: NTIS HC A11/MF A01 CSCL 13B

Methodology for the utilization of LANDSAT-1 imagery and aerial photography on the environmental evaluation of water resources development is presented. Environmental impact statements for water resource projects were collected and reviewed for the various regions of Texas. The environmental effects of channelization and surface impoundments are discussed for twelve physiographic regions of the state as delineated on black and white satellite (LANDSAT-1) mosaic of band 7. With the aid of LANDSAT-1 imagery, representative or typical transects were chosen within each region. Profiles of each site were constructed from topographic maps, and environmental data were accumulated for each site and related to low altitude aerial photography and enlarged LANDSAT-1 false color composites. GRA

N77-22589# American Society of Civil Engineers, New York. Urban Water Resources Research Council.
METHODS FOR CALCULATING MAXIMUM FLOOD DISCHARGES FOR NATURAL WATERCOURSES AND URBAN AREAS IN THE USSR
V. V. Kuprianov Aug. 1976 23 p refs
(Grant NSF ENG-74-20326)
(PB-262070/6; TM-IHP-5) Avail: NTIS HC A02/MF A01 CSCL 08H

Support of the international hydrological program Project 7: Effects of urbanization on the hydrological regime and on water quality is reported. Design criteria applicable to control of natural streams and sizing of facilities for urban drainage in the U.S.S.R. are defined. GRA

N77-22590# Regional Planning and Development Commission, Traverse City, Mich.
NORTHWEST MICHIGAN COASTAL ZONE MANAGEMENT
Jul. 1976 40 p
(PB-262947/5; NOAA-76121607; Rept-2) Avail: NTIS HC A03/MF A01 CSCL 13B

The measures which must be taken to enhance, preserve and use the qualities of the region's coastal zone are presented. These inventories, though incomplete, serve as the first comprehensive look at the region's shoreline in respect to the types of land use activity and natural phenomena occuring on the shoreline. GRA

N77-22591# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE PLAN (PUBLIC LAW 94-163, SECTION 154)
15 Dec. 1976 249 p
(PB-261737/1; FEA/S-76/458) Avail: NTIS HC A15/MF A01 CSCL 21D

The Energy Policy and Conservation Act requires the FEA to implement the Strategic Petroleum Reserve in order to mitigate the economic impacts of any future interruptions of petroleum imports. One hundred fifty MMB of oil will be stored by 1978 in the Early Storage Reserve, and five hundred MMB will be stored by 1982 under the full program. GRA

N77-22592# Virginia Polytechnic Inst. and State Univ., Blacksburg.
A MODEL FOR PREDICTING FLOOD HAZARDS DUE TO

SPECIFIC LAND-USE PRACTICES
B. B. Ross, D. N. Contractor, E. A. Li, V. O. Shanholtz, and J. C. Carr Sep. 1976 124 p refs Sponsored by Dept. of Interior
(PB-261389/1; VPI-VWRRC-Bull-99; W77-02078; OWRT-A-062-VA(2)) Avail: NTIS HC A06/MF A01 CSCL 13B

A finite element model for mathematically routing overland and channel flow when rainfall excess is known is developed. To determine rainfall excess, a procedure was developed to subdivide a drainage area into similarly responding units, defined as hydrologic response units. These units were functions of soil texture, soil depth, land use, and hydrology group classification. A computer model, based on the Mein and Larson and Holtan infiltration equations, was developed to generate excess precipitation for each hydrologic response unit. GRA

N77-22593# Conservation Foundation, Washington, D. C.
BARRIER ISLANDS AND BEACHES. TECHNICAL PROCEEDINGS OF THE 1976 BARRIER ISLANDS WORKSHOP
John Clark Sep. 1976 160 p refs Proc. held at Annapolis, 17-18 May 1976 Sponsored by NOAA
(PB-262964/0; ISBN-0-89164-035-5; NOAA-76121608; LC-76-46759) Avail: NTIS HC A08/MF A01 CSCL 13B

Barrier Islands as significant ecosystems, comparative ecology of east coast barrier islands--hydrology, soil, vegetation, the wildlife resoures of barrier islands, the national interest in barrier islands and beaches--natural resources values and barrier islands as natural storm dependent systems were discussed. Barrier beachfronts, environmental considerations and the management of barrier islands--St. George Island and the Apalachicola Bay System, Barrier Island preservation--the Virginia Coast reserve system, and critical area designation--the coastal zone soup bowl were examined. The Florida critical area program--ideas for Barrier island protection, barrier islands, barrier beaches, and the national flood insurance program, and aesthetic and recreation factors in Barrier Island planning were also surveyed. GRA

N77-22594# Connecticut Dept. of Environmental Protection, Hartford. Coastal Area Management Program.
DEVELOPER'S HANDBOOK
Allen Carroll 1976 64 p
(PB-262985/5; NOAA-76111040) Avail: NTIS HC A04/MF A01 CSCL 13B

The Developers' Handbook is designed to provide some basic information and advice on subdivision planning. The major natural systems and resources are briefly explained, and the opportunities and limitations they impose on development are summarized. A system of evaluating the characteristics of potential development is outlined. Several pages of sketches with accompanying paragraphs explain subdivision design and construction practices. GRA

N77-22595# Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
OPTICAL REMOTE SENSING OF WATER POLLUTANTS Completion Report, Jul. 1973 - Jun. 1976
J. J. Gallagher and J. B. McManus Aug. 1976 30 p refs
(Contract DI-14-31-0001-4010)
(PB-261346/1; ERC-0876; W77-02192; OWRT-A-046-GA(1)) Avail: NTIS HC A03/MF A01 CSCL 13B

Calculations were performed to compare three optical scattering processes for remote sensing of water pollutants. The relative merits of the Raman effect, the resonance Raman effect and fluorescence are discussed. The greater intensity of the fluroescence signal was considered in comparing these techniques for remote sensing. Instrumentation of laser sources applicable to water pollutants monitored was investigated to identify sources currently available for light scattering experiments. Preliminary measurements of Raman scattering using a single monochromator, an argon ion laser as the excitation source and photon counting techniques were performed. GRA

N77-22596# Hawaii Univ., Honolulu. Hawaii Geothermal Project.
LEGAL AND PUBLIC POLICY SETTING FOR GEOTHERMAL RESOURCE DEVELOPMENT IN HAWAII
Robert M. Kamins and Donald Kornreich Feb. 1976 102 p refs Sponsored by NSF and ERDA
(PB-262910/3; NSF/RA-760400) Avail: NTIS HC A06/MF A01 CSCL 08I

Social policy issues raised by the prospects for geothermal resource development in the state of Hawaii are considered. Exploration of the geothermal potential, legal considerations, regulation of geothermal resource exploitation, and state geothermal development policy are discussed. GRA

N77-22597# Minnesota Univ., Minneapolis. Water Resources Research Center.
THE 8TH ANNUAL WATER RESOURCES SEMINAR: GROUNDWATER RESOURCES AND DEVELOPMENT
May 1976 53 p refs
(OWRT Proj. A-999-MINN(40))
(PB-261491/5; WRRC-Bull-87; W77-02223) Avail: NTIS HC A04/MF A01 CSCL 13B

The proceedings of a conference on groundwater are presented. Topics include issues and trends in groundwater use, occurrence, and quality of groundwater in Minnesota, monitoring of groundwater, stormwater as a potential contaminant, and regional approaches to groundwater management. GRA

N77-22598# Washington Univ., Seattle. Charles W. Harris Hydraulics Lab.
SOME CONSEQUENCES OF AREA WIDE RUNOFF CONTROL STRATEGIES IN URBAN WATERSHEDS
Richard A. Hardt and Stephen J. Burges Jun. 1976 90 p refs
(Contract DI-14-31-0001-6050; OWRT Proj. A-078-WASH(1))
(PB-261258/8; W77-01947; TR-48) Avail: NTIS HC A05/MF A01 CSCL 08H

Hypothetical watersheds were studied to determine some bounds to the overall runoff management issue. Developments in urban and suburban areas to maintain peak flow rates from their sites at the level that existed prior to urbanization were examined. GRA

N77-22599# National Oceanic and Atmospheric Administration, Miami, Fla. Alantic Oceanographic and Meteorological Labs.
AN EXPERIMENT TO EVALUATE SKYLAB EARTH RESOURCES SENSORS FOR DETECTION OF THE GULF STREAM
George A. Maul, Howard R. Gordon, Stephen R. Baig, Michael McCaslin, and Roger De Vivo Aug. 1976 77 p refs
(PB-262420/3; AOML-23; NOAA-TR-ERL-378; NOAA-76112405) Avail: NTIS HC A05/MF A01 CSCL 08C

An experiment to evaluate the SKYLAB Earth Resources Package for observing ocean currents was performed in the Straits of Florida. Data from the S-190 photographic facility, S-191 spectroradiometer, and the S-192 multispectral scanner were compared with surface observations made simultaneously. GRA

N77-22600# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
IMPLEMENTATION OF COASTAL CURRENT-MAPPING HF RADAR SYSTEM Progress Report
D. E. Barrick and M. W. Evans Jul. 1976 74 p refs
(PB-261926/0; NOAA-TR-ERL-373; WPL-47; NOAA-76101207; PR-1) Avail: NTIS HC A04/MF A01 CSCL 08B

A concept for radar remote sensing of near surface ocean currents in coastal regions is described, and progress is reviewed on the design and construction of the first units. In an operational system, a radar pair will take simultaneous measurements over an ocean area with a grid having a 3-km spacing. Vectors will be constructed for each 3-km square section, and a map of the near surface current field will be output in real time by a minicomputer on site. All radar and digital gear is contained in two shock-mounted fiberglass cases, only 44 inches high and weighing under 200 pounds. The radar antenna are easily erectable frames holding three vertical aluminum pipes. The entire system can be set up in less than one hour. GRA

N77-22601# National Geodetic Survey, Rockville, Md.
DETERMINATION OF NORTH AMERICAN DATUM 1983 COORDINATES OF MAP CORNERS

T. Vincenty Oct. 1976 14 p ref
(PB-262442/7; NOAA-TM-NOS-NGS-6; NOAA-76112905) Avail: NTIS HC A02/MF A01 CSCL 08B

The use of Doppler data is reported in predicting approximate changes of coordinates of map corners from the North American Datum 1927 (NAD 27) to the North American Datum 1983 (NAD 83) system. A brief description of the computer program and pertinent mathematical formulas are included. GRA

N77-22602# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
ON SHALLOW-HOLE TEMPERATURE MEASUREMENTS. A TEST STUDY IN THE SALTON SEA GEOTHERMAL FIELD
Tien-Chang Lee 1976 40 p refs
(Grant NSF AER-72-03551)
(PB-262643/0; IGPP-UCR-76-6; NSF/RA-760426) Avail: NTIS HC A03/MF A01 CSCL 08I

Two numerical methods based on non-linear least-squares curve fitting are derived to remove the effect of annual temperature wave at the ground surface. One method gives the gradient and diffusivity as a function of depth while the other gives the weighted average values. Experiments were carried out in six test holes cased with 2 cm O.D. pvc pipes in the Salton Sea geothermal field. GRA

N77-22603# Colorado School of Mines, Golden.
GEOTHERMAL EXPLORATION: AN EVALUATION OF THE MICROSEISMIC GROUNDNOISE METHOD Ph.D. Thesis
Jacob Jerome Skokan 1974 126 p refs
(PB-262575/4; T-1701; NSF/RA/N-74-318) Avail: NTIS HC A07/MF A01 CSCL 08I

An attempt to test the geothermal-groundnoise hypothesis--that is: geothermal reservoirs are dynamic systems and can be located by measuring ground motion above them-resulted in extensive groundnoise surveys in two areas which appear to have great geothermal potential. These surveys were carried out at Kilauea Volcano, and the East Rift of Kilauea Volcano, on the island of Hawaii. Even in this relatively ideal environment, the surveys indicated changes in the acoustic properties of rocks, rather than changes in groundnoise activity resulting from dynamic geothermal reservoirs. GRA

N77-22604# Little (Arthur D.), Inc., Cambridge, Mass.
OUTER CONTINENTAL SHELF OIL AND GAS COSTS AND PRODUCTION VOLUME: THEIR IMPACT ON THE NATION'S ENERGY BALANCE TO 1990 Final Report
Frederick W. Mansvelt Beck and Karl M. Wiig Jul. 1976 241 p refs
(Contract DI-08550-CTS-48)
(PB-262533/3; ADL-78526; BLM/SE-77-01) Avail: NTIS HC A11/MF A01 CSCL 08I

The costs of finding and producing oil and gas in the OCS, estimates of the quantities likely to be produced in 1980, 1985, and 1990 under various price scenarios, and estimates of the potential regional and national impact on energy demand and supply are given. The resource estimates for the Outer Continental Shelf provided by the USGS were for offshore areas with water not deeper than 600 feet. GRA

N77-22605# Stanford Research Inst., Menlo Park, Calif.
OPTICAL BASES FOR REMOTE BIOLOGICAL AEROSOL DETECTION Quarterly Progress Report, 17 Mar. - 2 Jul. 1976
William B. Grant Nov. 1976 18 p
(Contract DAAA15-76-C-0042; DA Proj. 1W7-62711-AP-34; SRI Proj. 4805)
(AD-A032472; ED-CR-76103; QPR-2) Avail: NTIS HC A02/MF A01 CSCL 15/2

Measurements and calculations are being made to determine whether lidar techniques based on fluorescence and scatter can remotely detect and identify biological aerosols. The spectrofluorimeter has been calibrated. A forward-scatter instrument has been assembled to monitor aerosol flow rate. The facilities for generating aerosols have been assembled, tested, and calibrated. Aerosol concentrations up to 80 mg/cu m have been generated from 1% solutions of ammonium fluorescein. The mass median diameters of the dried particles are in the range of 2 to 5 micrometer. Preliminary measurements of the excitation and fluorescence spectra of aerosols of ammonium fluorescein and tryptophan have been made. A 20-m cell for the measurement of extinction by aerosols has been purchased. GRA

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N77-22606* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GELS AS BATTERY SEPARATORS FOR SOLUABLE ELECTRODE CELLS Patent
Dean W. Sheibley and Randall F. Gahn, inventors (to NASA) Issued 19 Apr. 1977 6 p Filed 20 Jul. 1976 Supersedes N76-28643 (19 - 44, p 2478)
(NASA-Case-LEW-12364-1; US-Patent-4,018,971; US-Patent-Appl-SN-707124; US-Patent-Class-429-105; US-Patent-Class-429-107; US-Patent-Class-429-190; US-Patent-Class-253-317) Avail: US Patent Office CSCL 09C

Gels are formed from silica powders and hydrochloric acid. The gels are then impregnated into a polymeric foam and the resultant sheet material is then used in applications where the transport of chloride ions is desired. Specifically disclosed is the utilization of the sheet in electrically rechargeable redox flow cells which find application in bulk power storage systems.
Official Gazette of the U.S. Patent Office

N77-22607* National Aeronautics and Space Administration. Pasadena Office, Calif.
SOLAR HYDROGEN GENERATOR Patent
Daniel I. Sebacher and Alexander P. Sabol, inventor (to NASA) Issued 26 Apr. 1977 5 p Filed 24 Mar. 1976 Supersedes N76-19564 (14 - 10, p 1273)
(NASA-Case-LAR-11361-1; US-Patent-4,019,868; US-Patent-Appl-SN-669928; US-Patent-Class-23-281; US-Patent-Class-23-277R; US-Patent-Class-55-158; US-Patent-Class-423-648R) Avail: US Patent Office CSCL 10A

An apparatus, using solar energy to manufacture hydrogen by dissociating water molecules into hydrogen and oxygen molecules is described. Solar energy is concentrated on a globe containing water thereby heating the water to its dissociation temperature. The globe is pervious to hydrogen molecules permitting them to pass through the globe while being essentially impervious to oxygen molecules. The hydrogen molecules are collected after passing through the globe and the oxygen molecules are removed from the globe.
Official Gazette of the U.S. Patent Office

N77-22608*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PHOTOVOLTAIC SYSTEM TEST FACILITY ELECTROMAGNETIC INTERFERENCE MEASUREMENTS
J. A. Johnson, F. P. Herke, Jr., and W. D. Knapp Apr. 1977 12 p ref
(Contract E(49-26)-1022)
(NASA-TM-X-73640; E-9142; ERDA/NASA-1022/77/11) Avail: NTIS HC A02/MF A01 CSCL 10A

Field strength measurements on a single row of panels indicates that the operational mode of the array as configured presents no radiated EMI problems. Only one relatively significant frequency band near 200 kHz showed any degree of intensity (9 muV/m including a background level of 5 muV/m). The level was measured very near the array (at 20 ft distance) while Federal Communications Commission (FCC) regulations limit

spurious emissions to 15 muV/m at 1,000 ft. No field strength readings could be obtained even at 35 ft distant. Author

N77-22609*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ERDA/LEWIS RESEARCH CENTER PHOTOVOLTAIC SYSTEMS TEST FACILITY
A. E. Forestieri, J. A. Johnson, W. D. Knapp, H. Rigo, J Stover, and R. Suhay Apr. 1977 34 p
(Contract E(49-26)-1022)
(NASA-TM-X-73641; E-9147; ERDA/NASA-1022/77/12) Avail: NTIS HC A03/MF A01 CSCL 10A

A national photovoltaic power systems test facility (of initial 10-kW peak power rating) is described. It consists of a solar array to generate electrical power, test-hardware for several alternate methods of power conversion, electrical energy storage systems, and an instrumentation and data acquisition system. Author

N77-22610*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
REAL TIME OUTDOOR EXPOSURE TESTING OF SOLAR CELL MODULES AND COMPONENT MATERIALS
Evelyn Anagnostou and America F. Forestieri Apr. 1977 13 p
(Contract E(49-26)-1022)
(NASA-TM-X-73655; ERDA/NASA-1022/77/10) Avail: NTIS HC A02/MF A01 CSCL 10A

Plastic samples, solar cell modules, and sub-modules were exposed at test sites in Florida, Arizona, Puerto Rico, and Cleveland, Ohio, in order to determine materials suitable for use in solar cell modules with a proposed 20-year lifetime. Various environments were encountered including subtropical, subtropical with a sea air atmosphere, desert, rain forest, normal urban, and urban-polluted. The samples were exposed for periods up to six months. Materials found not suitable were polyurethane, polyester, Kapton, Mylar, and UV-stabilized Lexan. Suitable materials were acrylic, FEP-A, and glass. The results of exposure of polyvinylidene fluoride were dependent on the specific formulation, but several types appear suitable. RTV silicone rubber (clear) appears to pick up and hold dirt both as a free film and as a potting medium for modules. The results indicate that dirt accumulation and cleanability are important factors in the selection of solar cell module covers and encapsulants. Author

N77-22611*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A LIGHTWEIGHT SOLAR ARRAY STUDY
Robert H. Josephs 15 Feb. 1977 39 p refs
(Contract NAS7-100)
(NASA-CR-152676; JPL-Publ-77-3) Avail: NTIS HC A03/MF A01 CSCL 10A

A sample module was assembled to model a portion of a flexible extendable solar array, a type that promises to become the next generation of solar array design. The resulting study of this module is intended to provide technical support to the array designer for lightweight component selection, specifications, and tests. Selected from available lightweight components were 127-micron-thick wrap-around contacted solar cells, 34-micron-thick sputtered glass covers, and as a substrate a 13-micron-thick polyimide film clad with a copper printed circuit. Each component displayed weaknesses. The thin solar cells had excessive breakage losses. Sputtered glass cover adhesion was poor, and the covered cell was weaker than the cell uncovered. Thermal stresses caused some cell delamination from the model solar array substrate. Author

N77-22612*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN INITIAL COMPARATIVE ASSESSMENT OF ORBITAL AND TERRESTRIAL CENTRAL POWER SYSTEMS Final Report
Richard Caputo Mar. 1977 160 p refs
(Contract NAS7-100)
(NASA-CR-152688; JPL-Doc-900-780) Avail: NTIS HC A08/MF A01 CSCL 10A

Orbital solar power plants, which beam power to earth by microwave, are compared with ground-based solar and conventional baseload power plants. Candidate systems were identified for three types of plants and the selected plant designs were then compared on the basis of economic and social costs. The representative types of plant selected for the comparison are: light water nuclear reactor; turbines using low BTU gas from coal; central receiver with steam turbo-electric conversion and thermal storage; silicon photovoltaic power plant without tracking and including solar concentration and redox battery storage; and silicon photovoltaics. Author

N77-22613*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR ENERGY IN BUILDINGS: IMPLICATIONS FOR CALIFORNIA ENERGY POLICY
Alan S. Hirshberg and E. S. Davis Mar. 1977 136 p refs
Sponsored in part by California Energy Resources Conservation and Development Commission
(Contract NAS7-100)
(NASA-CR-152686; JPL-Doc-5040-42) Avail: NTIS HC A07/MF A01 CSCL 10A

An assessment of the potential of active solar energy systems for buildings in California is summarized. The technology used for solar heating, cooling, and water heating in buildings is discussed. The major California weather zones and the solar energy designs are described, as well as the sizing of solar energy systems and their performance. The cost of solar energy systems is given both at current prices and at prices consistent with optimistic estimates for the cost of collectors. The main institutional barriers to the wide spread use of solar energy are summarized. Author

N77-22614*# Duke Univ., Durham, N.C. School of Engineering.
A THEORY OF CONTROL FOR A CLASS OF ELECTRONIC POWER PROCESSING SYSTEMS: ENERGY-STORAGE dc-TO-dc CONVERTERS Ph.D. Thesis
William W. Burns, III 25 Apr. 1977 257 p refs
(Grant NGL-34-001-001)
(NASA-CR-152696) Avail: NTIS HC A12/MF A01 CSCL 10A

An analytically derived approach to the control of energy-storage dc-to-dc converters, which enables improved system performance and an extensive understanding of the manner in which this improved performance is accomplished, is presented. The control approach is derived from a state-plane analysis of dc-to-dc converter power stages which enables a graphical visualization of the movement of the system state during both steady state and transient operation. This graphical representation of the behavior of dc-to-dc converter systems yields considerable qualitative insight into the cause and effect relationships which exist between various commonly used converter control functions and the system performance which results from them. Author

N77-22615*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHOD FOR PRODUCING SOLAR ENERGY PANELS BY AUTOMATION Patent Application
John C. Evans, Jr., inventor (to NASA) Filed 25 Apr. 1977 24 p
(NASA-Case-LEW-12541-1; US-Patent-Appl-SN-790637) Avail: NTIS HC A02/MF A01 CSCL 10A

The solar cell panel is fabricated by photoetching a pattern of collector grid systems with appropriate interconnection and bus bar tabs into a glass or plastic sheet and then filling these regions with a first, thin conductive metal film followed by a layer of a mixed metal oxide such as InAsO or InSnO. A multiplicity of solar cells are bonded between the protective sheet at the sites of the collector grid systems and a backelectrode substrate by conductive metal filled epoxy to complete the fabrication of an integrated solar panel. NASA

N77-22616# Bendix Corp., Kansas City, Mo.
DETECTION AND CONTROL OF POWER-LINE TRANSIENTS AFFECTING TESTER AND GAGE PERFORMANCE
J. W. Hill Aug. 1976 16 p refs
(Contract E(29-1)-613)
(BDX-613-1421) Avail: NTIS HC A02/MF A01

Certain indications of product failure obtained from product tester were suspected to be the result of short-duration power-line transients. Power lines were monitored and the type of transients that are most prevalent were determined to perform transient-immunity tests on product testers and other sensitive instruments,

and to make a survey of transient-protection methods that might be adopted. A power-line monitor was rented and evaluated. It performed all functions within specifications, but it was subject to errors caused by power-line transients in its own power input. The monitoring of power lines indicated that common transients were small in amplitude, with peaks of 50 volts, or less. Electrical storms were found to produce large numbers of transients with peaks exceeding 100 volts. Transient-immunity tests were performed on several product testers. ERA

N77-22617# Oak Ridge National Lab., Tenn.
THERMAL ENERGY STORAGE FOR BUILDING HEATING AND COOLING APPLICATIONS Quarterly Progress Report, Apr. - Jun. 1976
H. W. Hoffman and R. J. Kedl Nov. 1976 13 p
(Contract W-7405-eng-26)
(ORNL/TM-5700) Avail: NTIS HC A02/MF A01

Development of a time-dependent analytical model charged with a phase-change material was started. Preliminary data were obtained on the melt-freeze cycle behavior and viscosities of sodium thiosulfate pentahydrate and a mixture of Glauber's salt and borax; limited melt-freeze data were obtained on two paraffin waxes. ERA

N77-22618# Oak Ridge National Lab., Tenn.
IMPACT OF ALTERNATE FUELS ON INDUSTRIAL REFRACTORIES AND REFRACTORY INSULATION APPLICATIONS: AN ASSESSMENT
G. C. Wei and V. J. Tennery Sep. 1976 93 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5592) Avail: NTIS HC A05/MF A01

The effects of use of alternate fuels such as distillate oils, residual oils, coal, producer gas, and electricity on refractory insulation are evaluated. Sections are included on alternate fuels, assessment by industry of fuel conversion impact on industrial refractories, interactions of alternate fuel combustion products with refractories and refractory insulation, and analysis of degradation mechanisms in refractories and refractory materials. ERA

N77-22619# Battelle Pacific Northwest Labs., Richland, Wash.
MATHEMATICAL MODELING OF TOPOGRAPHIC EFFECTS OF WIND ENERGY SYSTEMS
B. E. Freeman Apr. 1976 26 p ref Presented at Intern. Symp. on Wind Energy Systems, Cambridge, UK, 7 Sep. 1976
(Contracts E(45-1)-1830; NSF C-1006; Grant NSF AER-75-00834)
(BNWL-SA-5935; Conf-760909-3) Avail: NTIS HC A03/MF A01

Meteorological phenomena taking place in regions comparable to the distance between synoptic weather stations (approximately 200 km) and in the immediate vicinity of the windmill site (approximately 1 km) are considered. Computer codes were developed for each of these regimes, and calculations of wind flow over complex terrain have been performed. Results of some of the wind calculations are presented, illustrating the effects of terrain on wind energy potential. ERA

N77-22620# Brookhaven National Lab., Upton, N.Y.
HYDROGEN STORAGE, WATER ELECTROLYSIS AND FUEL CELLS FOR ELECTRIC ENERGY STORAGE
F. J. Salzano, C. Braun, A. Beaufrere, S. Srinivasan, G. Strickland, and J. J. Reilly Apr. 1976 37 p refs Presented at Symp. on Energy Storage by an Electrochem. Method: Some New Methods, Grenoble, France, 9 Apr. 1976
(Contract E(30-1)-16)
(BNL-21498; Conf-760482-1) Avail: NTIS HC A03/MF A01

The process and physical configuration, performance and costs of such a system are presented and discussed, as well as the prognosis for eventual application in a utility system. The key requirement necessary to make hydrogen production attractive for utility applications is the flexible and maximum utilization of the capital facilities required for production, storage, and where applicable, electric conversion. ERA

N77-22621# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
SOLAR ENERGY ENVIRONMENTAL AND RESOURCE ASSESSMENT PROGRAM Summary Report
Oct. 1976 53 p
(ERDA-76-138) Avail: NTIS HC A04/MF A01

The goals, mission, and organization of the ERA Program are presented. The four ERA program areas are: environmental assessment, technology assessment, resource assessment, and material assessment. This report defines the scope of activities within each of the above program areas. Project summaries or abstracts for all projects are included. ERA

N77-22622# Los Alamos Scientific Lab., N. Mex.
CHEMISTRY OF THERMOCHEMICAL CYCLES FROM USA PROGRAMS
M. G. Bowman 1976 19 p refs Presented at AIM Intern. Congr. on Hydrogen and its Prospects, Liege, 15 Nov. 1976
(Contract W-7405-eng-36)
(LA-UR-76-1357; Conf-761102-2) Avail: NTIS HC A02/MF A01

Experimentally valid hydrogen production by thermochemical cycles are identified and described. These involve different chemical systems for which thermochemical data are usually available. This implies that additional (better) cycles will be found. Common problems of most cycles include: (1) manipulations involving solids; (2) drying large volumes of solutions; and (3) reactions where heat must be transferred to a solid from a heat exchanger surface. It seems clear that engineering assessment of such problems in specific cycles could lead to variations that improve the process. This feed-back procedure might produce a practical process. ERA

N77-22623# Los Alamos Scientific Lab., N. Mex.
GEOTHERMAL CHEMISTRY ACTIVITIES AT LASL Progress Report, Jan. - Dec. 1975
J. Balagna, R. Charles, and R. Vidale Oct. 1976 30 p refs
(Contract W-7405-eng-36)
(LA-6448-PR) Avail: NTIS HC A03/MF A01

The nature of rock-fluid interactions was studied using both new and standard hydrothermal systems. Permeability measurements using a newly developed technique to allow measurements at elevated temperature and pressure (up to 200 C and 0.4 kb confining pressure) show granite has a minimum in situ permeability of a few tenths of a microdarcy. Noncirculating systems, rocking vessels and static vessels are used to approximate the steady state reactions found in a slow moving geothermal system. Solutions in these systems approach steady state equilibrium in a matter of hours. The sequence of mineral reactivity is quartz greater than feldspar much greater than mafic minerals for all solutions used. Solution composition reached a steady state in a few days in the temperature range 200 C to 300 C. ERA

N77-22624# Sandia Labs., Livermore, Calif.
DEVELOPMENT OF THE SOLAR POWER CENTRAL RECEIVER CONCEPT
L. M. Murphy and A. C. Skinrood Sep. 1976 26 p refs
(Contract E(29-1)-789)
(SAND-76-8677) Avail: NTIS HC A03/MF A01

The role and use of the Sandia solar thermal test facility, is described. Futhermore, details of particular subsystem components, as well as potentially fruitful research areas for Sandia and other development laboratories to pursue which can lead to performance improvements, are discussed. ERA

N77-22625# General Atomic Co., San Diego, Calif.
RADIOISOTOPE SPACE POWER GENERATOR Annual Report, 1 Jul. 1974 - 30 Jun. 1975
N. B. Elsner, J. Chin, and H. G. Staley 30 Jul. 1976 91 p refs
(Contract E(04-3)-67)
(GA-A-14016) Avail: NTIS HC A05/MF A01

Experimental efforts were directed toward determining (1) the vapor species of TPM-217 from 700 to 1100 C, (2) the weight loss rate for TPM-217 at 900 C in vacuo, and (3) the stability of TPM-217 material in contact with Mo, Fe, 316 stainless steel, and pyrocarbon. The Si-Ge program is a continuation of the experimental work performed during FY-74. The development of coatings to suppress the vaporization of SiMo and SiGe continued. Techniques for applying ion-plated and chemical-vapor-

deposited coatings of Si3N4 and (Si,Al)N alloys on SiMo were examined. Methods of controlling morphology and the chemical composition of these coatings were developed. Rates of vaporization for coated samples at 1100 C were measured. ERA

N77-22626# Energy Research and Development Administration, Bartlesville, Okla. Energy Research Center.
HEATING OILS, 1976
Ella Mae Shelton Aug. 1976 43 p refs
(BERC/PPS-76/4) Avail: NTIS HC A03/MF A01

Properties of 297 heating oils marketed in the United States were submitted for study and compilation. The fuels were manufactured by petroleum refining companies in domestic refineries. The data are tabulated according to six grades of fuel and subdivided into five geographic regions in which the fuels are marketed. The five regions containing a total of 16 marketing districts are shown on a map in the report. Trend charts are included showing average properties of the six grades of fuel for the past several years. Summaries of the results of the tests by grade and by region for 1976 compared with data for 1975. ERA

N77-22627# California Univ., Livermore. Lawrence Livermore Lab.
ENERGY AND TECHNOLOGY REVIEW
Robert W. Selden, ed., Richard B. Crawford, ed., Kent L. Cummings, ed., and Judyth K. Prono, ed. Aug. 1976 18 p refs
(Contract W-7405-eng-48)
(UCRL-52000-76-8) Avail: NTIS HC A02/MF A01

The electric gun, a versatile tool for studying initiation properties of expolsives; microcomputers and computer networks; and the preferred parts concept, which may mean that metric conversion will pay for itself by elimination of duplication, are described. Brief items also report on progress in geothermal programs, the lithium-water-air battery program, and uncertain conclusions in the study of ozone depletion. Separate abstracts are prepared for the individual articles for inclusion in the data base. ERA

N77-22628# Battelle Pacific Northwest Labs., Richland, Wash.
ANALYSIS OF OIL PRODUCTS OBTAINED FROM CELLULOSE AT HIGH TEMPERATURE AND PRESSURE
D. J. Wiggins and T. F. Demmitt 1976 31 p refs Presented at the Rocky Mountain Regional Meeting of the Am. Chem. Soc., Laramie, Wyoming, 17 Jun. 1976
(Contract E(45-1)-1830)
(BNWL-SA-5681; Conf-760661-2) Avail: NTIS HC A03/MF A01

Research on determining the fundamental mechanism for the conversion of cellulose into liquid fuels is reported. A systematic investigation is made of the conversion of cellulose, components of cellulose, such as cellobiose and glucose, and structurally altered cellulose to oil in the presence of a variety of additives. An attempt is being made to elucidate the reaction mechanism by identifying the reaction products. The emphasis is on the identification of the reaction products which are produced when cellulose is exposed to high temperature and pressure in the presence of an additive. Author (ERA)

N77-22629# Argonne National Lab., Ill. Solar Energy Group.
PRISMS WITH TOTAL INTERNAL REFLECTION AS SOLAR REFLECTORS
Ari Rabl May 1976 37 p refs
(Contract W-31-109-eng-38)
(ANL-SOL-76-04) Avail: NTIS HC A03/MF A01

The suitability of TIR (Total Internal Reflection) prismatic reflectors for solar energy collection is investigated systematically. ERA

N77-22630# Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Research and Development Div.
ECONOMIC FEASIBILITY: FUEL GRADE METHANOL FROM COAL
Arthur McGeorge 1976 61 p refs Sponsored by ERDA
(TID-27156) Avail: NTIS HC A04/MF A01

A plant to make fuel grade methanol from coal based on partial oxidation pressure gasifiers and low pressure methanol synthesis is described. The process is capital intensive and thus is sensitive to plant investment but relatively insensitive to coal price. The financing method is important because of the capital intensive nature of the process. Shipping and distribution costs, assuming a mix of tank wagons, tank cars, unit trains and terminals, were estimated to be about 11 cents/gal. ERA

N77-22631# Argonne National Lab., Ill.
HIGH-PERFORMANCE BATTERIES FOR OFF-PEAK ENERGY STORAGE AND ELECTRIC-VEHICLE PROPULSION Progress Report, Apr. - Jun. 1976
Jul. 1976 62 p refs
(Contract W-31-109-eng-38)
(ANL-76-81) Avail: NTIS HC A04/MF A01

The present cells, which operate at 400 to 450 C, are vertically oriented, prismatic cells with a central positive electrode of FeS or FeS2, two facing negative electrodes of lithium-aluminum alloy, and an electrolyte of molten LiCl-KCl. Efforts are also under way to develop improved cell feedthroughs and electrode separators. Design work is in progress on a 30-kWh battery for a small four-passenger vehicle; this effort includes design calculations and setting specifications for the vehicle. Other battery engineering work is directed to the development of monitoring and cycling equipment and battery components. Cell chemistry studies include the wetting of materials by molten LiCl-KCl and potentiometric measurements on metal sulfide phases. Work is continuing on the development of alternative secondary cell systems. ERA

N77-22632# Battelle Pacific Northwest Labs., Richland, Wash.
USER MANUAL FOR GEOCOST: A COMPUTER MODEL FOR GEOTHERMAL COST ANALYSIS. VOLUME 2: BINARY CYCLE VERSION
H. D. Huber, R. A. Walter, and C. H. Bloomster Mar. 1976 180 p refs
(Contract E(45-1)-1830)
(BNWL-1942-V2) Avail: NTIS HC A09/MF A01

A computer model called GEOCOST was developed to simulate the production of electricity from geothermal resources and calculate the potential costs of geothermal power. GEOCOST combines resource characteristics, power recovery technology, tax rates, and financial factors into one systematic model and provides the flexibility to individually or collectively evaluate their impacts on the cost of geothermal power. Both the geothermal reservoir and power plant are simulated to model the complete energy production system. In this version of GEOCOST, geothermal fluid is supplied from wells distributed throughout a hydrothermal reservoir through insulated pipelines to a binary power plant. The power plant is simulated using a binary fluid cycle in which the geothermal fluid is passed through a series of heat exchangers. ERA

N77-22633# California Univ., Livermore. Lawrence Livermore Lab.
FIBER COMPOSITE PROGRAM FOR FLYWHEEL APPLICATIONS Quarterly Progress Report, Jan. - Mar. 1976
R. G. Stone, T. T. Chiao, J. A. Rinde, L. S. Penn, L. L. Clements, and E. Wu May 1976 12 p
(Contract W-7405-eng-48)
(UCRL-50033-76-1) Avail: NTIS HC A02/MF A01

E-glass is the cheapest of the strong, light filamentary materials and thus a promising candidate for flywheels for which cost is more critical than weight. Performance data are meager and not considered reliable. Type 30 E-glass, a 2,000-filament per strand material, is being studied because large strands minimize winding time and costs. With the very large number of filaments per strand, difficulties were encountered in proper strand wetting, void content, uneveness of filaments, and the winding process. Also the strength of the strands exceeded the capacity of the standard stress-rupture fixtures. These difficulties have been resolved, and consistent, reliable data are now being obtained. Thermal as well as stress properties have been determined. New stress-rupture fixtures have been completed and testing started. ERA

N77-22634# Sandia Labs., Albuquerque, N.Mex.
MATHEMATICAL MODELING OF SOLAR CONCENTRATORS
F. Biggs and C. N. Vittitoe 1976 15 p refs Presented at

Sharing the Sun, Solar Technol. in the Seventies, Winnipeg, Canada, 15 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-5641; Conf-760821-8) Avail: NTIS HC A02/MF A01

A computational capability that models the operation of any solar energy collector that uses flux concentrators is a valuable aid in the planning, design, construction, calibration, safety analysis, and operation of the system. In addition to the usual optical considerations, the model should treat such imperfections as reflecting-surface slope errors, suntracking and alignment errors, and mirror-focusing errors. It should properly account for the angular distribution of incoming sun rays and the effects of atmospheric transmission on this distribution. A model with these capabilities is described, and two computer programs for implementing it are illustrated. GRA

N77-22635# Sandia Labs., Albuquerque, N.Mex.
FOCUSED SOLAR COLLECTOR ANALYSIS WITH AXIALLY VARYING INPUT DUE TO SHADOWING FROM ADJACENT COLLECTORS
D. O. Lee and W. P. Schimmel, Jr. 1976 23 p refs Presented at Natl. Heat Transfer Conf., St. Louis, Mo., 8 Aug. 1976 Sponsored by ERDA
(SAND-76-5061; Conf-760816-1) Avail: NTIS HC A02/MF A01

An analytical expression for the shadowing of a collector by adjacent units as a function of collector location, spacing, and orientation is presented. Hourly variations of solar input are accounted for as are the seasonal effects of solar zenith angle. Using the shadowing expression, an axial temperature differential analysis is used to determine the output of a linear focused solar collector being shadowed by adjacent collectors. Outputs for a typical spacing configuration are presented for a north-south oriented collector field. Calculations are based on fixed tilt east-west tracking systems. The effect of the time of day on the collector output is included for the equinoxes and solstices for Albuquerque, N. M. ERA

N77-22636# Sandia Labs., Livermore, Calif. Solar Energy Technology Div.
POTENTIAL OF A SOLAR COLLECTOR WITH A STATIONARY SPHERICAL REFLECTOR AND A TRACKING ABSORBER FOR ELECTRICAL POWER PRODUCTION
A. M. Clausing (Ill. Univ., Urbana, Ill.) Aug. 1976 48 p refs
(Contract E(29-1)-789)
(SAND-76-8039) Avail: NTIS HC A03/MF A01

A fixed segment of a concave spherical mirror can be used to concentrate beam radiation onto a tracking absorber which pivots about the center of curvature of the mirror. A possible economic advantage of this system over concentrating collectors with tracking mirrors is reduced mirror cost. The characteristics of this system are analytically studied. The strong influences of the geometrical parameters of the stationary reflector/tracking absorber system are established. The penalty caused by the fixed reflector and the influence of the absorber temperature is also determined. The daily and yearly variations in the power produced by the system are presented. ERA

N77-22637# Energy Research and Development Administration, Washington, D.C.
COMPARISON OF DIFFERENT WIND ENERGY CONVERSION SYSTEMS. PART 1: THE NOAH SYSTEM COMPARED WITH THE ULRICH HUTTER SYSTEM
1976 10 p refs
(Contract E(29-2)-3533)
(RFP-Trans-204-Pt-1) Avail: NTIS HC A02/MF A01

The analysis is made within the framework of structural components which are generally important for wind energy systems. Advantages and disadvantages are evaluated from technical viewpoints (type of construction, novelty, susceptibility to failure, ease of repairs, maintenance requirements), as well as in terms of expected power, performance, manufacturing cost and economy. ERA

N77-22638# Battelle Pacific Northwest Labs., Richland, Wash.
INFLUENCE OF SELECTED FEDERAL STATUTES ON ENERGY DEVELOPMENT
M. Curry and M. Greene Jun. 1976 87 p refs
(BNWL-2084(RAP-5)) Avail: NTIS HC A05/MF A01

The characteristics of the Pacific Northwest region and of the energy development/production process are described. A general overview of the Federal legislative constraints and incentives, including some discussion of their content and the implications of each piece of legislation for energy resource development, is provided. ERA

N77-22639# Energy Research and Development Administration, Washington, D.C. Div. of Solar Energy.
NATIONAL PROGRAM FOR SOLAR HEATING AND COOLING OF BUILDINGS: PROJECT DATA SUMMARIES. VOLUME 1: COMMERCIAL AND RESIDENTIAL DEMONSTRATION
Aug. 1976 170 p 3 Vol.
(Contract EG-77-C-05-5297)
(ERDA-76-127) Avail: NTIS HC A08/MF A01

The commercial demonstration program includes a wide variety of building types, such as: office buildings, schools, fire stations, civic centers, factories, libraries, etc. The residential demonstration program includes both single and multi-family dwellings. ERA

N77-22640# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN, VOLUME 1
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and R. W. Wallace Dec. 1975 239 p refs
(Contract NSF-C-389)
(PB-261566/4; NSF/RA/N-75-093A-Vol-1) Avail: NTIS HC A11/MF A01 CSCL 10A

The techniques used to develop plans for geothermal research are detailed. Programs and subprograms are described for each type of geothermal resource, as are recommended program budgets and time schedules. Five- and ten-year program plans in this study emphasize critical five-year milestones. GRA

N77-22641# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN. VOLUME 1: APPENDIX A: GLOSSARY. APPENDIX B: TASK ANALYSIS SHEETS
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, G. H. Stewart, and R. W. Wallace Dec. 1975 425 p
(Contract NSF C-389)
(PB-261567/2; NSF/RA/N-75-093B-Vol-1-App-A; NSF/RA/N-75-093B-Vol-1-App-B) Avail: NTIS HC A18/MF A01 CSCL 10A

A comprehensive project-oriented plan has been developed to best meet the national objectives in geothermal research, to be performed during the next ten years. GRA

N77-22642# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A US GEOTHERMAL RESEARCH PLAN. VOLUME 2: EXECUTIVE SUMMARY
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and R. W. Wallace Dec. 1975 64 p refs
(Contract NSF C-389)
(PB-261568/0; NSF/RA/N-75-093-Vol-2) Avail: NTIS HC A04/MF A01; also avail. in set of 3 reports as PC E11, PB-261565-SET CSCL 10A

A comprehensive, project-oriented plan was developed to best meet the national objectives in geothermal research to be performed during the next ten years. Necessary projects and tasks are defined under each of the subprograms such that each geothermal resource can become economically viable within a ten-year period. Recommended five-year budgets are selected on the basis of the allocations model. GRA

N77-22643# Battelle Pacific Northwest Labs., Richland, Wash.
RECOMMENDATIONS FOR A GEOTHERMAL UTILIZATION PLAN, VOLUME 3
J. B. Burnham, C. H. Bloomster, P. D. Cohn, J. R. Eliason, P. L. Peterson, C. A. Rohrmann, G. A. Sandness, D. H. Stewart, and

R. W. Wallace Dec. 1975 20 p
(Contract NSF C-839)
(PB-261569/8; NSF/RA/N-75-093C-Vol-3) Avail: NTIS HC A02/MF A01; also avail. in set of 4 reports PC E11, PB-261565 SET CSCL 10A

Volume III, describes the general principles used in the design of the utilization projects, and discusses the details of these projects and tasks as developed under each of the various resources. GRA

N77-22644# Battelle Columbus Labs., Ohio.
ENERGY USE PATTERNS IN METALLURGICAL AND NONMETALLIC MINERAL PROCESSING (VOLUME 1, PHASE 6: ENERGY DATA AND FLOW SHEETS, LOW-PRIORITY COMMODITIES) Final Report
21 Jul. 1976 275 p refs
(Contract DI-BM-SO-144093)
(PB-261150/7; BM-OFR-117-76-Vol-1) Avail: NTIS HC A13/MF A01 CSCL 08I

Descriptions are given of mineral processing, flow sheets, and energy content for each stage of processing for 43 low-priority commodities (on the basis of volume produced and total energy content) including 33 minor metals such as bismuth, cadmium, gold, and hafnium, and 10 nonmetallic products such as gem stones, graphite, bauxite, iodine, and crushed and sized stones. GRA

N77-22645# Battelle Columbus Labs., Ohio.
ENERGY USE PATTERNS IN METALLURGICAL AND NONMETTALIC MINERAL PROCESSING (VOLUME 1, PHASE 9: AREAS WHERE ALTERNATIVE TECHNOLOGIES SHOULD BE DEVELOPED TO LOWER ENERGY USE IN PRODUCTION OF HIGH-PRIORITY COMMODITIES), SUPPLEMENT Final Report
25 Aug. 1976 76 p refs
(Contract DI-BM-SO-144093)
(PB-261153/1; BM-OFR-117-76-Vol-1-Suppl) Avail: NTIS HC A05/MF A01 CSCL 08I

An analysis is given of areas where alternative technologies should be developed to reduce energy required in the production of 14 high-volume commodities. Primary attention is given to aluminum, lime, cement, common brick, copper, glass, iron and steel slabs and castings, lead, nitrogen-ammonia, phosphorus-phosphoric acid, basic and fireclay refractories, sulfuric acid, and zinc. GRA

N77-22646# Shell Oil Co., Houston, Tex. Mining Ventures Dept.
EVALUATION OF COMBINED IN-SITU AND SURFACE RETORTING OF OIL SHALE TRACT C-b
A. P. Grossman Nov. 1976 33 p refs
(Contract DI-14-09-0070-653)
(PB-261064/0; B-OFR-116-76) Avail: NTIS HC A03/MF A01 CSCL 08I

A case for modified in-situ oil shale retorting process is discussed in combination with surface retorting of higher grade shales. Examples and costs are given for an oil shale tract. GRA

N77-22647# Southern Methodist Univ., Dallas, Tex.
DEVELOPMENT OF LOW-COST THIN-FILM POLYCRYSTALLINE SILICON SOLAR CELLS FOR TERRESTRIAL APPLICATIONS Semiannual Progress Report, 1 Jan. - 30 Jun. 1976
T. L. Chu Jul. 1976 54 p refs
(Grants NSF AER-73-07843; NSF GI-38981)
(PB-260627/5; NSF/RANN/SE/AER73-07843/PR-76; NSF/RA-760299) Avail: NTIS HC A04/MF A01 CSCL 10B

The electrical and structural properties of epitaxial silicon layers on recrystallized metallurgical silicon are investigated. Silicon solar cells are prepared by depositing the active region of the solar cell on recrystallized metallurgical silicon substrates using the thermal reduction of trichlorosilane containing appropriate dopants. At the present, the efficiency is about 5% for large area (30 sq cm) cells and is higher than 6% for smaller area (5 sq cm) cells. GRA

N77-22648# Westinghouse Electric Corp., Pittsburgh, Pa.
AC/DC POWER CONDITIONING AND CONTROL EQUIPMENT FOR ADVANCED CONVERSION AND STORAGE TECHNOLOGY Final Report
Peter Wood Nov. 1976 111 p
(PB-261585/4; EPRI-EM-271) Avail: NTIS HC A06/MF A01 CSCL 10B

It is concluded that the two most likely long-range candidates for converting dc to ac power from batteries and fuel cells are the basic current-fed line commutated inverter (a derivative of HVDC technology), and the voltaged-fed conduction angle controlled force commutated inverter. Results are presented for analyses of cost, performance, and reliability which lead to the identification of the current-fed line commutated technology as the most promising long-range choice. In addition, information about technology projections, control philosophy, commutating circuits is included in this report. GRA

N77-22649# Federal Energy Administration, Washington, D. C. Office of the Administrator.
REPORT OF THE PRESIDENTIAL TASK FORCE ON REFORM OF FEDERAL ENERGY ADMINISTRATION REGULATIONS, VOLUME 1
Dec. 1976 236 p refs Prepared in cooperation with the Council of Economic Advisors
(PB-262181/1; FEA/T-77/018) Avail: NTIS HC A11/MF A01 CSCL 10A

Results from a Presidential decision, in February 1976, to create independent task forces comprised of qualified personnel from other departments and agencies to assist certain Federal regulatory agencies in evaluating their regulations are reported. The issues discussed are: (1) simplifications or improvements in FEA price and allocation regulations, including regulations for FEA's mandatory oil import program; and (2) improvements in FEA procedures for developing, promulgating, and implementing regulations. GRA

N77-22650# Federal Energy Administration, Washington, D. C. Office of the Administrator.
REPORT OF THE PRESIDENTIAL TASK FORCE ON REFORM OF FEDERAL ENERGY ADMINISTRATION REGULATIONS, VOLUME 2. TABLE OF CONTENTS. APPENDIXES
Dec. 1976 193 p Prepared in cooperation with the Council of Economic Advisors
(PB-262182/9; FEA/T-77/019) Avail: NTIS HC A09/MF A01 CSCL 10A

The table of contents and appendices to the report of the Presidential Task Force on Reform of Federal Energy Administration Regulations, Volume 1 is given. GRA

N77-22651# California Inst. of Tech., Pasadena.
PALEOMAGNETIC DATING OF HOLOCENE VOLCANISM IN NORTHWESTERN UNITED STATES. A PRELIMINARY REPORT
Duane E. Champion and Eugene M. Shoemaker 1976 40 p refs Prepared in cooperation with Geol. Survey, Washington, D. C.
(Grant NSF AER-76-00634)
(PB-262433/6; NSF/RA-760405) Avail: NTIS HC A03/MF A01 CSCL 08I

A fairly good record of the variation in direction of the geomagnetic field in northwestern United States from 1500 BP to 3000 BP and from 5800 BP to 6900 BP has been obtained by measurement of dated volcanic rocks. A less complete record has been obtained for the variation in intensity of the field. On the basis of field evidence, paleomagnetic data, and a few 14C ages, the Holocene lavas of the Snake River Plains, Idaho, have been divided into three broad categories of age. Fairly specific ages are suggested for 2 previously undated lava flows on the Snake River Plain by comparing their directions of the magnetization with the known record of secular variation. Several tens of cubic kilometers of basalt erupted along the Great Rift during the Holocene. GRA

N77-22652# Lear Motors Corp., Reno, Nev.
GEOTHERMAL HOT WATER PUMP, APPENDIX
1976 115 p refs
(Grant NSF AER-74-18753)
(PB-262030/0; LMC-760504-A-App; NSF/RA-760380) Avail: NTIS HC A06/MF A01 CSCL 08I

A hot water pumping system for use in geothermal reservoirs

was developed. The system consists of a high speed electric motor driven submersible pump which can operate at depths of 1,000 feet or more, and at temperatures up to (232C). Six appendixes are presented in this report: (1) generator computer analysis; (2) power transmission cable vendor data; (3) electric motor computer analysis; (4) motor electrical insulation vendor data; (5) electromagnetic material vendor data; and (6) motor test procedure. GRA

N77-22653# Systems Science and Software, La Jolla, Calif.
GEOHYDROLOGICAL ENVIRONMENTAL EFFECTS OF GEOTHERMAL POWER PRODUCTION, PHASE 2A Final Report, 1 Jun. 1975 - 1 Jun. 1976
J. W. Pritchett, S. K. Garg, D. H. Brownell, Jr., L. F. Rice, and M. H. Rice Sep. 1976 188 p refs
(Grant NSF AER-75-14492)
(PB-261687/8; SSS-R-77-2998; NSF/RA-760317) Avail: NTIS HC A09/MF A01 CSCL 08I

A fully active geothermal reservoir simulator for simultaneous treatment of fluid flow and ground movement effects was developed. Application of the reservoir simulator to a two-dimensional vertical model of the Wairakei geothermal system has successfully reproduced the total fluid production history. GRA

N77-22654# Texas Univ., Dallas. Richardson Inst. for Geosciences.
THERMAL CONDUCTIVITY MEASUREMENT AND PREDICTION FROM GEOPHYSICAL WELL LOG PARAMETERS WITH BOREHOLE APPLICATION
Ronald Gross and Jim Combs 1976 35 p refs
(Grants NSF GI-36250; NSF AER-72-03551)
(PB-262372/6; NSF/RA-760364; Contrib-291) Avail: NTIS HC A03/MF A01 CSCL 08I

Measurements on each of 50 samples were made for thermal conductivity, bulk density, porosity, permeability, electrical resistivity and conductivity, compressional and shear velocity, and free fluid index. These physical properties were analyzed to derive predictive equations for thermal conductivity. Application of these relationships to thoroughly investigated geothermal borehole sections indicates that prediction from standard geophysical well logs may be more reliable than cell measurements in determining the thermal conductivity of unconsolidated sedimentary sequences. GRA

N77-22655# Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering.
TDIST, A PROGRAM FOR COMMUNITY ENERGY DEMAND ANALYSIS AND TOTAL ENERGY SYSTEM RESPONSE SIMULATION. USER'S MANUAL Final Report
John W. Stetkar and Michael W. Golay 31 Aug. 1976 296 p refs
(Contract DAAK02-74-C-0308)
(AD-A033301; USAFESA-RT-2024) Avail: NTIS HC A13/MF A01 CSCL 09/2

TDIST, the Thermal Distribution System Simulation Code, is a computer program developed at MIT to aid in the design and dynamic performance analysis of a large integrated Total Energy System (TES) supplying thermal and electrical energy to a multi-consumer-type metropolitan area. Included in this User's Manual are derivations of the detailed consumer energy demand models and of the Thermal Utility System (TUS) component models developed in each of the system analysis subroutines. Comprehensive modelling scenarios are presented to illustrate how these program components are combined to yield a range of steady-state and dynamic system analysis options. Program execution information includes descriptions of the three primary modes of program operation, complete documentation of input requirements and data card formats, examples of available data output options, and a lareting of the code. Sample data is included for the execution of a 24-hour dynamic simulation of a TES serving a community of 50,000. Author (GRA)

N77-22656# Office of Naval Research, London (England).
THE 10TH INTERNATIONAL POWER SOURCES SYMPOSIUM
W. G. Soper 21 Oct. 1976 14 p refs Symp. held at Brighton, Engl., 13-16 Sep. 1976
(AD-A033323; ONRL-C-30-76) Avail: NTIS HC A02/MF A01 CSCL 10/1

A summary is given of the 10th International Power Sources Symposium at which 48 papers were presented. Emphasis in the review is placed upon secondary batteries with high energy density, i.e., those most suitable for electrically powered vehicles. An introductory discussion of the principles of batteries and measures of performance is also included. Author (GRA)

N77-22657# Kansas Univ. Center for Research, Inc., Lawrence.
ASSESSMENT OF FUEL-CONSERVATION POTENTIAL OF A GROUND-TRANSPORTATION SYSTEM DUE TO FULL UTILIZATION OF ITS MASS TRANSPORTATION CAPABILITIES Final Report
Joe Lee Jan. 1977 134 p refs
(Grant NSF KO-42151)
(PB-262125/8; CRINC-2620-01) Avail: NTIS HC A07/MF A01 CSCL 13B

The approach is experimental rather than theoretical. A selected city, in this case Kansas City, Kansas was evaluated. The specific works include the estimation of existing excessive mass transit capacity, the auto trips that potentially can be diverted to use mass transit, and the fuel savings due to such diversions. Results have an acceptable accuracy, and the procedures developed are useful for assessing fuel saving capability of a ground transportation system under an emergency situation. A manual describing the general use of the developed procedures is included. GRA

N77-22658# Rosenblatt (M.) and Son, Inc., Arlington, Va.
ENERGY RECOVERY SYSTEM FOR SHIPS Final Report
D. Yuengling, A. Baki, and J. Richard 16 Dec. 1976 183 p Prepared in cooperation with George Washington Univ.
(Contract MA-6-38010)
(PB-262124/1; MA-RD-930-77014) Avail: NTIS HC A09/MF A01 CSCL 13J

The results of a feasibility investigation of various heat recovery concepts which may be incorporated in an existing marine steam plant are reported. The use of different refrigerant fluids, as well as different types of energy recovery units, is examined, and a plan developed for prototype development, installation, and test. GRA

N77-22659# Energy Resources Co., Inc., Cambridge, Mass.
ENVIRONMENTAL RESEARCH NEEDS FOR COAL CONVERSION AND COMBUSTION TECHNOLOGIES Final Report
John Ehrenfeld, Barry Gehron, Miriam Goldberg, John Gushue, and Ben Ross Dec. 1976 307 p refs
(Contract EQ6AC007)
(PB-262159/7; EQ-517613007) Avail: NTIS HC A14/MF A01 CSCL 21D

Coal combustion technology in the econmy is investigated. This aim stresses current and near-term understanding of sources, effects and consequences, rather than ultimate fundamental knowledge of all of the causal mechanisms leading to the generation, transport, control and effects of pollutants. GRA

N77-22660# Naval Postgraduate School, Monterey, Calif.
EXAMINATION OF LASER-PRODUCED PRESSURE PULSES IN A GALLIUM ARSENIDE SOLAR CELL M.S. Thesis
John Frank Jacobson Jun. 1976 127 p refs
(AD-A031893) Avail: NTIS HC A07/MF A01 CSCL 10/3

Pressure pulses caused by irradiation of a model gallium arsenide solar cell with a Carbon Dioxide TEA Laser were examined using power densities of the order of 10 to the 7th power watts/sq cm. The pressure pulses were monitored with a Sandia type quartz pressure gauge. It was discovered that the relatively low power densities used were capable of removing the silicon dioxide antireflective and gold contact layers of the solar cell after only a few shots of the laser. An exponential relationship between the initial thicknesses of these layers and the pressure pulse generated in the gallium arsenide substrate was indicated for gold contact layers of less than 5000 A thickness. Evidence was found that the principal pressure generation mechanism is thermo-mechanical. Gold films of thickness greater than 5000 A were found to be able to absorb the power densities used with no apparent damage. Author (GRA)

N77-22661# Naval Postgraduate School, Monterey, Calif.
A REVIEW OF MATERIALS AND MECHANISMS WHICH AFFECT THE PERFORMANCE OF LEAD-ACID STORAGE BATTERIES Interim Report, Jun. - Sep. 1976
Jeff Perkins, J. L. Pokorny, and M. T. Coyle Oct. 1976 79 p refs
(AD-A032299; NPS-69PS76101) Avail: NTIS HC A05/MF A01 CSCL 10/3

Principles governing the performance of the various materials used in contemporary lead-acid storage batteries are reviewed. It is shown how basic developments in materials science and electrochemical technology have led to substantial improvements in this well-established engineering system. The recent use of sophisticated microanalytical techniques to study battery plate behavior has contributed considerable insight into the mechanisms affecting performance under various conditions. These results are reviewed, and their relevance to service behavior is emphasized. The interrelationships between the various component materials of lead-acid systems - grid alloys, active material compounds, polymeric separators, and conductors and containers - are considered. Author (GRA)

N77-22662# Naval Postgraduate School, Monterey, Calif.
MICROSTRUCTURAL COMPARISON OF POSITIVE FLOAT AND TRICKLE DISCHARGE OPERATIONS ON THE POSITIVE ELECTRODES OF SUBMARINE STORAGE BATTERIES WITH LEAD-CALCIUM ALLOY GRIDS M.S. Thesis
Michael Thomas Coyle Sep. 1976 177 p refs
(AD-A032298) Avail: NTIS HC A09/MF A01 CSCL 10/3

Lead-calcium alloy grid batteries are utilized as the backup emergency power supply on non-diesel-electric submarines. Sudden and premature capacity losses have been experienced when these batteries are operated in a float mode while in standby conditions, hence a continuous drain, or trickle discharge, is maintained in lieu of float. This requires periodic battery charges to restore full capacity. The microstructural effects of float and trickle discharge operation on positive plates from small cells, manufactured from full size submarine battery plates, are studied using a scanning electron microscope. This is complemented with light microscopy observations and x-ray diffraction analysis. A patterned dendritic network of spiny crystals was discovered to be prevalent in the trickle-discharged plates. This network was seen on the grid surface corrosion layer and on a dense layer found in the internal active material. It is postulated that this network may be related to lead-sulfate dissolution upon recharge. Author (GRA)

N77-22663# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID ELECTROLYTES: ALKALI-ION TRANSPORT IN SKELETON STRUCTURES Semiannual Technical Summary Report, 1 Jan. - 30 Jun. 1976
John B. Goodenough, Henry Y.-P. Hong, James A. Kafalas, and Kirby Dwight 30 Jun. 1976 23 p refs
(Contract F19628-76-C-0002; Grant NSF AER-74-02094; ARPA Order 2696)
(AD-A032342; ESD-TR-76-242) Avail: NTIS HC A02/MF A01 CSCL 10/2

A new three-dimensional K(+)-ion conductor, K(1.9)Mg(0.95)Si (1.05)O(4) has been identified. Its resistivity at 300C is 28 ohm-cm, less than one-fourth the value for the best potassium beta-alumina. More definitive measurements have been made of the Na(+)-ion transport in Na3Zr2Si2PO12 (NASICON). Its resistivity at 300C is 3 ohm-cm, compared with 4 ohm-cm for beta double prime-alumina. Moisture tests have shown that NASICON is insensitive to water vapor. Static tests in molten Na2S4 for 10 days at 400C indicate chemical stability; similar tests in molten Na and dynamic tests in a Na-Na cell are in progress. Conclusive evaluation of stability awaits the preparation of additional test specimens. GRA

N77-22664# EIC, Inc., Newton, Mass.
LITHIUM-INORGANIC ELECTROLYTE BATTERIES Quarterly Report, 16 Mar. - 15 Jun. 1976
Joseph R. Driscoll, Gerhard L. Holleck, David E. Toland, and S. Barry Brummer Oct. 1976 47 p refs
(Contract DAAB07-74-C-0030)
(AD-A031601; C-401; ECOM-74-0030-11; QR-11) Avail: NTIS HC A03/MF A01 CSCL 10/3

An SOCl2-based, Li primary battery operable over the temperature range -40 to +160 F is being evaluated. The desired energy density is 150 watt-hours per pound of total battery weight and the desired power density is 50 watts per pound. GRA

N77-22665# Defence Research Establishment Ottawa (Ontario).
NICKEL/CADMIUM AIRCRAFT BATTERIES: HIGH RATE DISCHARGE EQUIPMENT
K. Feldman, R. L. Haines, and W. LePage Sep. 1976 24 p
(AD-A031866; DREO-TN-76-22) Avail: NTIS HC A02/MF A01 CSCL 10/3

Factors that are not of major significance in low rate battery discharges become quite important when a battery is used to crank an aircraft turbine engine. Apparatus was designed and built to facilitate the study of nickel/cadmium aircraft batteries when used in this and other high rate applications. Maximum discharge rates of 1000 amperes or more are possible with 24-volt batteries. Load configurations may be readily modified. Discharge profiles are simulated by use of fixed load steps which may be timed either automatically or manually. This document describes the equipment and gives instructions for its use. Author (GRA)

N77-22666# Naval Postgraduate School, Monterey, Calif.
AN OPTIMIZATION STUDY OF A LOW THERMAL POTENTIAL POWER SYSTEM Final Report
J. R. Buckingham, W. M. Raike, and M. D. Kelleher Sep. 1976 111 p refs
(AD-A031709; NPS-69Kk76091) Avail: NTIS HC A06/MF A01 CSCL 10/2

A power generating system using the low thermal potential available from the vertical temperature distribution of the ocean is analyzed as a combined engineering and economic mathematical model. The model is optimized for minimum capital cost employing a sequential unconstrained minimization algorithm. Examples of the kinds of engineering and cost information available from the model are presented. Author (GRA)

N77-22667# RAND Corp., Santa Monica, Calif.
CALIFORNIA'S ENERGY FUTURE
Deane N. Morris Mar. 1976 31 p
(AD-A032221; P-5616) Avail: NTIS HC A03/MF A01 CSCL 10/1

This paper presents an abridgement of the results of a Rand study on energy policy issues facing California, more fully reported in Energy Alternatives for California: Paths to the Future, R-1793-CSA/RF, and summarized in some detail in an Executive Summary, R-1793/1-CSA/RF. The study is concerned with the problems of an uncertain future. These problems are extraordinarily complex and interwoven. Under conditions of rapid change, the full consequences of policy actions are difficult to predict and policy objectives are difficult to define. In addition, the relationships between state and federal actions are poorly understood, involving issues of equity among individuals and regions, and issues of environment, health, safety, and land use. Simple solutions should not be expected in such a policy area. However, a number of recommendations are presented because policy decisions should be made on the basis of the best information available when the political process demands they be made. The brief summary presented here necessarily omits most of the rationale for our conclusions and recommendations, as well as a number of subsidiary conclusions. The interested reader should consult the full report for these additional details. Author (GRA)

N77-22668# KVB Engineering, Inc., Tustin, Calif.
CONTROL OF OXIDES OF SULFUR FROM STATIONARY SOURCES IN THE SOUTH COAST AIR BASIN OF CALIFORNIA Final Report, Jun. 1975 - Jun. 1976
S. C. Hunter and N. L. Helgeson Jun. 1976 341 p refs
(Contract ARB-4-421)
(PB-261754/6; KVB-5802-432; ARB-R-4-421-76-53) Avail: NTIS HC A15/MF A01 CSCL 13B

An inventory of oxides of sulfur (SOx) emissions from stationary sources in the South Coast Air Basin of California was compiled for 1974. Emissions from over 1,580 point sources were assessed from device and fuel use information provided by the device operators and local air pollution control

districts. Sulfur oxide emissions were estimated to be 342 tons per day on an annual average basis in 1974. Power plants were the dominant source category, followed by refineries, carbon plants, and a variety of smaller sources. Some emission tests were conducted to verify the inventory. Forecasts made to 1980 indicate substantial increases over 1974 emissions as the result of increased fuel oil burning. GRA

N77-22669# National Bureau of Standards, Washington, D. C. Center for Building Technology.
INTERIM PERFORMANCE CRITERIA FOR SOLAR HEATING AND COOLING SYSTEMS IN COMMERCIAL BUILDINGS
Nov. 1976 102 p
(Contract E(49-1)-3800)
(PB-262114/2; NBSIR-76-1187) Avail: NTIS
HC A06/MF A01 CSCL 13A

These interim criteria have the following objectives: (1) to provide designers, manufacturers and evaluators with the technical performance criteria that will be used for the commercial solar heating and cooling demonstration program; (2) to establish technical performance levels that will be used for evaluation and procurement of systems, subsystems and components for the commercial solar heating and cooling demonstration program; and (3) to provide a basis for the development of more definitive performance criteria at a later date. GRA

N77-22670# Simulation Physics, Inc., Burlington, Mass.
SILICON THIN FILM CRYSTALLIZATION AND SOLAR CELL FABRICATION Quarterly Progress Report, Jun. - Sep. 1976
A. R. Kirkpatrick, T. P. Shaughnessy, and M. Oren Oct. 1976 82 p refs
(Grant NSF AER-76-06096)
(PB-261715/7; QR-10045-2; QPR-2; NSF/RA-760333) Avail: NTIS HC A05/MF A01 CSCL 10B

First, the feasibility of fabricating high efficiency solar cells from thin films using a novel technique, electrostatic bonding, and transferring the film from a temporary growth substrate to glass encapsulating superstrate, is demonstrated. This is the key program task since the fabrication technology developed can be applied to a wide range of film types and deposition procedures. The second program task, the recrystallization of thin-film silicon, also involves an innovative approach. This approach is based upon the use of high-efficiency directed energy sources to raise thin films to high recrystallization temperatures without substrate heating. GRA

N77-22671# Washington Univ., Seattle. Inst. for Environmental Studies.
ELECTRIC POWER DEVELOPMENT IN THE PACIFIC NORTHWEST REGION: INSTITUTIONAL COMMITMENTS AND ALTERNATIVES, PHASE 1 Interim Report
Kai N. Lee, Marion E. Marts, Robert G. Walton, and Alison D. Birmingham 1 Sep. 1976 167 p refs
(Contract DI-14-34-0001-6050)
(PB-262382/5; W77-03288; OWRT-A-080-WASH (1)) Avail: NTIS HC A08/MF A01 CSCL 10B

Pacific Northwest regional electric power development was studied with three objectives: (1) to assemble an historical account of institutional arrangements for electric power development in the region, (2) to identify emergent public policy issues; and (3) to identify long-range institutional research and problems relevent to regional energy and resources development. GRA

N77-22672# American Cyanamid Co., Stamford, Conn. Chemical Research Div.
CADMIUM STANNATE SELECTIVE OPTICAL FILMS FOR SOLAR ENERGY APPLICATIONS Final Report, 1 Jul. 1973 - 31 Aug. 1976
G. Haacke and L. C. Burton (Del. Univ., Newark) Sep. 1976 70 p refs
(Grant NSF AER-73-07957)
(PB-261850/2; NSF/RA-760309) Avail: NTIS
HC A04/MF A01 CSCL 10B

The development of cadmium stannate coatings for utilization in solar energy converters is reviewed and evaluated. GRA

N77-22673# Department of Health, Education, and Welfare, Washington, D.C. Office of Consumer Affairs.
BUYING SOLAR
Joe Dawson Jun. 1976 81 p refs
(PB-262134/0; FEA/G-76/154) Avail: NTIS
HC A05/MF A01 CSCL 13A

Guidelines for the consumer interested in buying a solar system are provided to help the homeowner considering the use of solar energy for space heating and cooling, and domestic water heating. The guidelines also help the consumer to make informed decisions based on geographic location, type of home, quality of insulation, present energy costs, and type of solar system intended for purchase. Engineering terms used to evaluate or describe solar products are also included. GRA

N77-22674# Energy Resources Council, Washington, D. C.
PERSPECTIVE ON ENERGY POLICY
Elliot L. Richardson and Frank G. Zarb 16 Dec. 1976 119 p
Sponsored by Federal Energy Admin.
(PB-261736/3; FEA/T-76/514) Avail: NTIS
HC A06/MF A01 CSCL 21D

This is an overview of areas where accomplishments have been made, areas where changes are needed, and initiatives which should be analyzed in greater depth. The following issues are discussed: energy situations, Federal regulatory policy, energy conservation, energy development, electric utility regulatory reform, nuclear energy, energy financing, energy R&D priorities, international considerations and Federal energy organization. GRA

N77-22675# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME 1
Dec. 1976 583 p refs 2 Vol.
(PB-261799/1; FEA/S-76/487-Vol-1; FES-76/2-Vol-1) Avail: NTIS HC A25/MF A01 CSCL 21D

It is proposed that crude oil be stored underground in solution-mined salt cavities and in conventional mines. However, modification to the proposal may require that petroleum products be stored aboveground in tanks. This programmatic EIS (Environmetal Impact Statement) identified particularly sensitive environmental parameters that are being investigated in more detail in specific EIS's for each candidate site. GRA

N77-22676# Federal Energy Administration, Washington, D. C. Strategic Petroleum Reserve Office.
STRATEGIC PETROLEUM RESERVE. FINAL ENVIRONMENTAL IMPACT STATEMENT, VOLUME 2
Dec. 1976 273 p refs 2 Vol.
(PB-261800/7; FEA/S-76/488-Vol-2; FES-76/2-Vol-2) Avail: NTIS HC A12/MF A01 CSCL 21D

Comments on the programmatic environmental impact statement (Volume 1) from federal, state, and local agencies and private industry concerning storage of crude oil underground in solution--mined salt cavities and in conventional mines are presented. GRA

N77-22677# Federal Energy Administration, Washington, D. C. Office of Energy Resources Development.
ELECTRIC UTILITY FINANCE WORKSHOP
Jul. 1976 31 p Proceedings held at Washington, D. C., 20 Jul. 1976
(PB-261661/3; FEA/G-76/496) Avail: NTIS
HC A03/MF A01 CSCL 10A

Contents: National policy on need for new electric generating capacity; national policy on fuel choice; areas of innovation; possible federal initiatives with respect to electric utilities. GRA

N77-22678# Alaska Univ., College. Geophysical Inst.
GEOTHERMAL ENERGY AND WIND POWER: ALTERNATE ENERGY SOURCES FOR ALASKA
R. B. Forbes, ed. Apr. 1976 256 p refs Conf. Proc. of the Alaskan Geothermal and Wind Power Resources Planning Conf., Anchorage, Alaska, 8-9 Jul. 1975 Prepared in cooperation with the Alaska Energy Office, Juneau
(Grant NSF AER-75-20207)
(PB-261521/9; NSF/RA-760246) Avail: NTIS
HC A12/MF A01 CSCL 10A

The Alaskan energy problems that can be alleviated through wind and geothermal resources are defined, and recommended plans for the initiation of state and federal programs are presented. Working groups were formed in the following areas: agriculture, electrical power, fisheries and agriculture, geothermal resource research and development, space heating and industrial application, and wind power development and applications. GRA

N77-22679# General Electric Co., Washington, D.C. Center for Energy Systems.
ENERGY INPUT-OUTPUT MODELLING: PROBLEMS AND PROSPECTS Final Report
James M. Griffin Nov. 1976 123 p refs Sponsored by Electric Power Research Inst.
(PB-261925/2; EPRI-EA-298) Avail: NTIS HC A06/MF A01 CSCL 10A

The methodological differences and empirical justification for the use of physical energy I-O coefficients, which rely on real dollar flows were investigated. Energy-oriented applications of i-O analysis were reviewed. These include applications based on physical and on real dollar flows. These studies range from static energy I-O coefficient analysis of the Btu content of an auto to efforts to dynamize I-O models by allowing the coefficients to change in response to relative prices and technology. GRA

N77-22680# Geonomics, Inc., Berkeley, Calif.
GEOTECHNICAL ENVIRONMENTAL ASPECTS OF GEOTHERMAL POWER GENERATION HEBER, IMPERIAL VALLEY, CALIFORNIA Topical Report, no. 1
Oct. 1976 100 p refs Sponsored by Electric Power Research Inst.
(PB-260848/7; EPRI-ER-299) Avail: NTIS HC A05/MF A01 CSCL 10B

The feasibility of constructing a 25 to 50 MWe geothermal power plant using low salinity hydrothermal fluid as the energy source was assessed. The geotechnical aspects of geothermal power generation and their relationship to environmental impacts in the Imperial Valley of California were investigated. Geology, geophysics, hydrogeology, seismicity and subsidence in terms of the availability of data, state-of-the-art analytical techniques, historical and technical background and interpretation of current data are discussed. GRA

N77-22681# Gordian Associates, Inc., New York.
UCAN TECHNICAL IMPLEMENTATION MANUAL. Final Report
Aug. 1976 192 p refs
(Contract FEA-CO-04-60448-00)
(PB-261094/7; FEA/D-76/387) Avail: NTIS HC A09/MF A01 CSCL 10A

The methods available to utility companies, public service commissions and public interest organizations to ensure the successful implementation of utility rate reform, load management, insulation programs, energy efficiency promotion, interior environment consultation services, building code revisions, energy audit programs and elimination of master metering are presented. It highlights the differences in implementation strategies for gas and electric utilities. GRA

N77-22682# Gordian Associates, Inc., New York.
STUDY OF TECHNICAL OPTIONS AVAILABLE FOR RECLAIMING HEAT LOST TO THE ATMOSPHERE FROM EXISTING MECHANICAL DRAFT COOLING TOWERS Final Report
Nov. 1976 27 p refs
(Contract FEA-CO-04-50235-00)
(PB-261752/0; FEA/D-76/199) Avail: NTIS HC A03/MF A01 CSCL 10A

Options available were investigated for the recovery of waste heat currently lost to the atmosphere from mechanical draft cooling towers. A variety of useful purposes to which the warm water may be put, are listed. The use of heat pipes for more efficient heat exchange is described. GRA

N77-22683# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
CONCEPTUAL DESIGN OF A 10MW REGENERATIVE ISOBUTANE GEOTHERMAL POWER PLANT
Ashok K. Gupta and James L. S. Chou 15 Oct. 1976 81 p refs
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261563/1; HGP-TR-18; NSF/RA-760377) Avail: NTIS HC A05/MF A01 CSCL 10B

The regenerative binary cycle, as applied to the geothermal brines for the generation of power, is evaluated. To improve the thermal efficiency of the basic cycle, a regenerative heat exchanger is used to transfer the heat from the turbine exhaust to the compressed isobutane entering the main heat exchanger. This results in reducing the size of the condenser, cooling equipment, and the main heat exchanger. Another effect is the increase of the temperature of the waste brine so that the waste heat could be utilized effectively. GRA

N77-22684# Hawaii Univ., Honolulu. Dept. of Mechanical Engineering.
WORKING FLUID SELECTION AND PRELIMINARY HEAT EXCHANGER DESIGN FOR A RANKINE CYCLE GEOTHERMAL POWER PLANT
Deane H. Kihara and Paul S. Fukunaga 1976 30 p refs Presented at 2d United Nations Symp. on the Develop. and Use of Geothermal Resources, San Francisco, 20-29 May 1975
(Contract E(04-3)-1093; Grant NSF GI-38319)
(PB-261564/9; HGP-TR-20; NSF/RA-760378) Avail: NTIS HC A03/MF A01 CSCL 10B

A list of possible working fluids with wide ranges of property values is examined, and two, isobutane and R-114, are selected as being representative of the type of working fluid that might be selected by plant engineers. Heat exchangers will be at the interface between the geothermal fluid and the working fluid and will constitute an essential component of this particular means of energy conversion. A parametric study is conducted of a vertical, counterflow, shell and tube heat exchanger designed for use in a 10 MW geothermal power plant which utilizes geothermal brine at moderate temperatures. The computational procedure for determining the required brine flow rate, tube lengths, number of tubes, and pressure drops is outlined. GRA

N77-22685# Hawaii Inst. of Geophysics, Honolulu.
A COORDINATED EXPLORATION PROGRAM FOR GEOTHERMAL SOURCES ON THE ISLAND OF HAWAII Progress Report, May 1973 - Apr. 1975
Augustine S. Furumoto 30 Apr. 1975 35 p refs
(Grant NSF GI-38319)
(PB-261691/0; HIG-Contrib-673; NSF/RA/N-75-348) Avail: NTIS HC A03/MF A01 CSCL 08I

Infrared scanning surveys by aircraft followed by reconnaissance-type electrical surveys and ground noise surveys narrowed down the promising area to the east rift of Kilauea. The surveys carried out over the east rift included magnetic, gravity, and electrical surveys by various methods; microearthquake surveillance; temperature profiling of wells; and chemical analysis of water samples. Aeromagnetic, regional gravity, and crustal seismic refraction data were available in the published literature. A model of the thermal structure of the east rift was put together to account for the data. The dike complex through which magma from the central vent of Kilauea travels laterally occupies a zone 3 km wide extending from 1 km to 5 km depth. On the south side of the dike complex, there may be a self-sealing geothermal reservoir where groundwater heated by the dike complex is trapped. Not all of the dike complex is hot; hot sections seem to occur in patches. GRA

N77-22686# Mathematica, Inc., Philadelphia, Pa. Div. of Energy.
SOURCES OF ENERGY DATA FOR ILLINOIS Final Report
Jeffrey P. Price and Janet S. Farr Aug. 1976 390 p Sponsored by the Ill. Dept. of Business and Economic Development, Springfield
(PB-262562/2; ILLDOE-76/01) Avail: NTIS HC A17/MF A01 CSCL 10A

A compendium of Illinois statistical data sources and an assessment of their important characteristics is presented. The data sources are generated from institutions both within Illinois and elsewhere in the country. The types of data identified are statistical data relating to Illinois energy demand and end use, supply, flow, prices, facilities, processing, exploration, production,

and resources, as well as related demographic, economic, and environmental data. GRA

N77-22687# Texaco, Inc., El Monte, Calif. Montebello Research Lab.
HYDROGEN PRODUCTION FROM COAL LIQUEFACTION RESIDUES Final Report
Allen M. Robin Dec. 1976 72 p
(PB-261734/8; EPRI-AF-233) Avail: NTIS HC A04/MF A01 CSCL 07A

High ash H-coal residues from the liquefaction of Illinois No. 6 and Wyodak coals were gasified. The synthesis gas produced consisted of over 92 volume percent carbon monoxide (CO) and hydrogen (H2) on a dry basis. Approximately 40 tons of each residue was gasified at 24 atmospheres pressure at residue feed rates up to 1/2 ton per hour. No major operating problems were experienced. Cold gas efficiencies averaged between 83 and 84 percent. Steam and oxygen requirements were comparable to those of heavy oil gasification. GRA

N77-22688# Martin Marietta Labs., Baltimore, Md.
BIOLOGICAL SOLAR ENERGY CONVERSON: APPROACHES TO OVERCOME YIELD, STABILITY AND PRODUCT LIMITATIONS Progress Report, 1 Apr. - 30 Sep. 1976
Bessel Kok, C. F. Fowler, H. H. Hardt, and R. J. Radmer 1976 42 p refs
(Grant NSF AER-73-03291)
(PB-261910/4; MML-TR-76-16c; NSF/RA-760313; PR-3) Avail: NTIS HC A03/MF A01 CSCL 06A

The rate inhibition induced by treating chloroplasts with glutaraldehyde is studied. The decay of activity of isolated chloroplasts stored in the dark is studied as a function of pH. The program concerning the size of the photosynthetic unit in relation to the utilization of high light includes studies of nitrogen-starved algae and the possible role of carotenoids which accumulate in these cells. No specific photochemical process driven by carotenoids in these organisms was detected. Comparative studies of the light gathering systems in the bundle sheath and mesophyll cells of C4 plants are initiated. GRA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N77-22689*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION CHROMATOGRAPHIC DETERMINATION OF ANIONS COLLECTED ON FILTERS AT ALTITUDES BETWEEN 9.6 AND 13.7 KILOMETERS
Dumas A. Otterson 1977 16 p refs Presented at Symp. on Ion Chromatog. Analysis of Environ. Pollutants, Research Triangle Park, N. C., 28 Apr. 1977; sponsored by EPA
(NASA-TM-X-73642; E-9143) Avail: NTIS HC A02/MF A01 CSCL 13B

The investigation of atmospheric pollution to determine the anion-containing particulates in the atmosphere at altitudes between 9.6 and 13.7 km is discussed. Air samples collected on cellulose fiber discs impregnated with dibutoxyethylphthalate require very sensitive methods of analysis. It is concluded that ion chromatography is suited for the determination of anions collected on the filters. Methods to control contamination and interfering side reactions are described. J.M.S.

N77-22690# Utah Univ., Salt Lake City.
TURBULENT DIFFUSION IN THE ERMAN BOUNDARY LAYER
J. N. Paegle and S. K. Kao Jan. 1976 27 p refs Presented at the Symp. on Atmospheric Turbulence, Diffusion, and Air Quality, Raleigh, North Carolina, 19 Oct. 1976
(Contract ET(11-1)-2455)
(COO-2455-11; Conf-761003-17) Avail: NTIS HC A03/MF A01

Numerical models are developed to simulate the dispersion pollutants emitted from a ground source in the Ekman boundary layer for three different boundary conditions. They are reflecting upper and lower boundaries, an open upper boundary and a reflecting lower boundary, and an open upper boundary and a total absorption lower boundary. It is shown that the maximum concentration generally shifts anticyclonically (toward the right in the Northern Hemisphere, left in the Southern Hemisphere) with increasing height as a consequence of the effects of the Coriolis and frictional forces in the planetary boundary layer. ERA

N77-22691# California Univ., Berkeley. Lawrence Berkeley Lab. Energy and Environment Div.
CHEMICAL CHARACTERIZATION OF AEROSOL SPECIES PRODUCED IN HETERGENEOUS GAS-PARTICLE REACTIONS
T. Novakov, S. G. Chang, R. L. Dod, and H. Rosen Jun. 1976 27 p refs Presented at the Air Pollution Control Association Ann. Meeting, Portland, Ore., 27 Jun. - 1 Jul. 1976 Sponsored in part by NSF
(Contract W-7405-eng-36)
(LBL-5215; Conf-760654-2) Avail: NTIS HC A03/MF A01

X-ray photo-electron spectroscopy, infrared, and Raman spectroscopy were applied to study ambient, source-enriched, and laboratory-generated aerosols. The principal conclusions reached in the course of this study are: in addition to ammonium salts such as ammonium nitrate and ammonium sulfate, particulate ammonium may also appear in a voltatile form independent of sulfate and nitrate. Studies of laboratory-generated aerosols indicate that the oxidation of SO2 on soot particles results in the formation of sulfate salt-like species. Their hydrolysis product readily forms ammonium sulfate, however, in reaction with gaseous ammonia. Measurements on source-enriched particles confirm the presence of nitrate produced in nonphotochemical gas-particle reactions. Raman spectroscopic results indicate that physical structures similar to activated carbon are present in ambient and source emission particles. ERA

N77-22692# Los Alamos Scientific Lab., N. Mex.
DEVELOPMENT OF AIR-MONITORING TECHNIQUES USING SOLID SORBENTS, LASL PROJECT R-059, NIOSH-IA-75-31 Progress Report, 1 Oct. 1975 - 31 Mar. 1976
G. O. Wood and R. G. Anderson Sep. 1976 26 p refs
(Contract W-7405-eng-36)
(LA-6513-PR) Avail: NTIS HC A03/MF A01

Work was continued toward specifying methods for measuring vapors of hydrazines and amines in air. The methods involve collecting vapors on silica gel or sulfuric acid-coated silica gel in a tube through which air is drawn. Vapor retention was studied on the latter sorbent for 1,1-dimethylhydrazine, morpholine, and cyclohexylamine. These results were used to design a sampling tube of sufficient capacity for 8-h monitoring of hydrazines or amines. Removal of the sample from the sorbent by elution with dilute acid or water was measured for hydrazines and aliphatic amines. Analyses of amines and of hydrazine reaction products of 2-furaldehyde was performed by gas chromatography. ERA

N77-22693# Comsis Corp., Glastonbury, Conn. Environmental Services.
OPEN SPACE AS AN AIR RESOURCE MANAGEMENT MEASURE. VOLUME 1: SINK FACTORS
Robert S. DeSanto, William H. Smith, Joseph A. Miller, William P. McMillen, and Kenneth A. MacGregor Oct. 1976 310 p refs
(Contract EPA-68-02-2350)
(PB-261758/7; H800-Vol-1; EPA-450/3-76-028a) Avail: NTIS HC A14/MF A01 CSCL 06F

Sink and emission factors standardized, where possible, into SI units of micrograms per square meter of surface area per hour are reported based on an extensive English and foreign language literature search. Approximately 2,000 English abstracts are listed derived from English, German, Russian, Japanese and other source literature. Data is reported relative to the removal of ammonia, carbon monoxide, chlorine, fluorine, hydrocarbons, nitrogen oxides, peroxyacetylnitrate particulates, and sulfur dioxide, by vegetation, soil and water. Emission of ammonia, carbon monoxide, hydrocarbons and nitrogen oxides are also reported to the extent that they are found in the literature. GRA

N77-22694# Comsis Corp., Glastonbury, Conn. Environmental Services.
OPEN SPACE AS AN AIR RESOURCE MANAGEMENT MEASURE. VOLUME 1A: APPENDIX TO SINK FACTORS Final Report
Robert S. Desanto, William H. Smith, Joseph A. Miller, William P. McMillen, and Kenneth A. MacGregor Dec. 1976 882 p (Contract EPA-68-02-2350)
(PB-261759/5; H800-Vol-1-App; EPA-450/3-76-028a-App) Avail: NTIS HC A99/MF A01 CSCL 06F

Abstracts of approximately 2,000 references are compiled in support of determining what is known about the sink and emission factors for air pollutants associated with soil and vegetation. Some very limited literature is also abstracted relative to water bodies as sink and sources of air pollutants. This abstracted bibliography is in support of the three volumes which comprise the final report of this project. GRA

N77-22695# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF, VOLUME 1 Principal Investigators' Reports, Apr. - Jun. 1976
Sep. 1976 951 p refs Sponsored by Bureau of Land Management
(PB-263064/8; NOAA-76122707-Vol-1) Avail: NTIS HC A99/MF A01 CSCL 13B

Quarterly reports of baseline studies on the environmental effects of the development of resources on the Alaska continental shelf are presented. Baseline studies encompass the marine mammals, birds, fish, plankton, benthos and littoral biota. GRA

N77-22696# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF, VOLUME 2 Principal Investigators' Reports, Apr. - Jun. 1976
Sep. 1976 873 p refs Sponsored by Bureau of Land Management
(PB-263065/5; NOAA-76122708-Vol-2) Avail: NTIS HC A99/MF A01 CSCL 13B

Quarterly reports of baseline studies on the environmental effects of the development of resources on the Alaska continental shelf are presented. Baseline studies encompass pollution effects, chemistry and microbiology, physical oceanography, geology, ice and data management. GRA

N77-22697# Massachusetts Inst. of Tech., Cambridge. Dept. of Ocean Engineering.
THE INTERACTION OF WAVES AND OIL SPILLS Ph.D. Thesis
Robert J. Stewart Sep. 1976 205 p refs
(Grant NOAA-04-5-158-1)
(PB-262458/3; MITSG-75-22; NOAA-76112416) Avail: NTIS HC A10/MF A01 CSCL 13B

The combined effects of interfacial elasticity and multiple fluid layer geometries upon the first order properties of surface waves are analyzed for application to the oil spill problem. The technique of matched asymptotic expansion is used in conjunction with a small amplitude assumption regarding the wave height. The theory of interfacial elasticity is briefly reviewed, and critical parameters are identified. Recommendations for further study of oil-water adsorption and mixed monolayer elasticities are developed. GRA

N77-22698# Cornell Univ., Ithaca, N.Y. Dept. of Chemistry.
COMPUTER INTERPRETATION OF POLLUTANT MASS SPECTRA Final Report, 1 Oct. 1972 - 30 Sep. 1975
Fred W. McLafferty Oct. 1976 70 p refs
(Grant EPA-R-801106)
(PB-262341/1; EPA-600/4-76-046) Avail: NTIS HC A04/MF A01 CSCL 07D

A new probability based matching (PBM) system for the retrieval of mass spectra from a large data base was developed that substantially improved the interpretation of unknown mass spectra using the self-training interpretive and retrieval system (STIRS). PBM was designed as a prefilter to STIRS; if an unknown mass spectrum can be identified with a sufficiently high confidence by PBM, interpretation of the spectrum using STIRS is not necessary. The PBM system provides more efficient retrieval than presently accepted systems; it incorporates a 'reverse search' algorith, and through the use of weighted mass and abundance data provides a statistically valid prediction of the confidence of the matches found. GRA

N77-22699# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Environmental Science.
ATMOSPHERIC FREONS AND HALOGENATED COMPOUNDS Final Report
Alan Appleby Nov. 1976 357 p refs
(Grant EPA-R-800833)
(PB-262432/8; EPA-600/3-76-108) Avail: NTIS HC A16/MF A01 CSCL 13B

Ambient levels of atmospheric Freons, halogenated hydrocarbons, and SF6 were measured at various locations in the U.S.A. Adventitious labeling of air masses with halogenated compounds was used to demonstrate urban ozone transport to rural areas. GRA

N77-22700# Research Triangle Inst., Research Triangle Park, N.C.
TECHNOLOGY AND ECONOMICS OF FLUE GAS NOx OXIDATION BY OZONE Final Report, Jul. - Oct. 1976
J. W. Harrison Dec. 1976 74 p refs
(Contract EPA-68-02-1325)
(PB-261917/9; EPA-600/7-76-033) Avail: NTIS HC A04/MF A01 CSCL 13B

Stationary combustion sources contribute about half the manmade NOx emitted to the atmosphere in the U.S. Flue gas from combustion processes contains NOx which is predominantly in the form of NO. Although NO2 is to some extent soluble in water or aqueous solutions, NO is practically insoluble when conventional scrubbing processes are used. For effective removal, the NO must either be reduced to elemental nitrogen or oxidized to NO2 or higher oxides which can be removed by scrubbing. GRA

N77-22701# Research Triangle Inst., Research Triangle Park, N.C.
COMPARATIVE US/USSR TESTS OF A HOT-SIDE ELECTROSTATIC PRECIPITATOR Final Report, Jan. 1975 - Sep. 1976
Charles H. Gooding, Joseph D. McCain, and Diane K. Sommerer Jan. 1977 74 p refs
(Contract EPA-68-02-1398)
(PB-261918/7; EPA-600/2-77-002) Avail: NTIS HC A04/MF A01 CSCL 13B

U.S. and Soviet equipment and procedures were used to determine flue gas composition and velocity, total particulate mass concentration of the gas stream, particle size distribution, electrical resistivity of the particulate entering the precipitator, evidence of back corona in the precipitator, SO2 and SO3 concentrations in the flue gas, and chemical composition of the fuel and fly ash. The test site and test procedures are described. Results of the comparative tests are presented and discussed. GRA

N77-22702# Research Corp. of New England, Wethersfield, Conn.
SYMPOSIUM ON FUGITIVE EMISSIONS MEASUREMENT AND CONTROL Final Report, Jun. 1975 - Jun. 1976
E. M. Helming Sep. 1976 315 p refs Proc. held at Hartford, 17-19 May 1976
(Contract EPA-68-02-2110)
(PB-261955/9; EPA-600/2-76-246) Avail: NTIS HC A14/MF A01 CSCL 13B

Airborne fugitive emissions from industrial sources, together with the air pollution control regulations and cost estimates, are discussed. I.M.

N77-22703# Rhode Island Univ., Kingston. Dept. of Plant and Soil Science.
THE CAPACITY OF SALT MARSH VEGETATION TO MODIFY THE QUALITY OF ESTUARINE WATERS Completion Report, 1 Jun. 1974 - 30 Sep. 1976
Richard J. Hull 30 Sep. 1976 36 p refs

(Contract DI-14-31-0001-4173)
(PB-261997/1; W77-02830; OWRT-B-062-RI(1)) Avail: NTIS HC A03/MF A01 CSCL 13B

The ability of tidal marsh vegetation to absorb nutrient and heavy metal ions introduced to the marsh by tidal flood waters was investigated. Water soluble salts of N, P, Cd, and Zn were applied to the marsh surface during low tide, and infiltration into the sediment was measured by analyzing water samples taken from wells placed 15, 30, 60 and 90 cm into the sediment. Ammonium, applied as urea, and phosphate penetrated the marsh sediment readily with most concentrated in the upper 15 to 30 cm. Spartina alterniflora growing on the marsh absorbed approximately 40 percent of the NH4(+) and 20 percent of the P applied. GRA

N77-22704# Midwest Research Inst., Kansas City, Mo.
PHYSICAL AND ECONOMIC DAMAGE FUNCTIONS FOR AIR POLLUTANTS BY RECEPTOR Final Report
Ben-chieh Liu and Eden Siu-Hung Yu Sep. 1976 172 p refs
(Contract EPA-68-01-2968)
(PB-262340/3; EPA-600/5-76-011) Avail: NTIS HC A08/MF A01 CSCL 13B

Regional economic damages to human health, material, and vegetation and of property soiling resulting from air pollution are evaluated. Frameworks of the physical and economic damage functions are developed for calculating comparable regional damage estimates. Aggregate economic damage functions instrumental for transforming the multivarious aspects of the pollution problem into a single, homogeneous monetary unit are tentatively derived and illustrated. GRA

N77-22705# Institute of Gas Technology, Chicago, Ill.
INITIAL ENVIRONMENTAL TEST PLAN FOR SOURCE ASSESSMENT OF COAL GASIFICATION Final Report, Jun. 1973 - Dec. 1974
A. Attari, M. Mensinger, and J. Pau Sep. 1976 146 p refs
(Contract EPA-68-02-1307)
(PB-261916/1; EPA-600/2-76-259) Avail: NTIS HC A07/MF A01 CSCL 13B

A source assessment environmental test plan, developed to investigate the fate of various constituents during coal gasification is described. The plan is an approach to the problems associated with sampling point selection, sample collection, and sample analysis which is based on a HYGAS-type process. GRA

N77-22706# Alsid, Snowden and Associates, Bellevue, Wash.
CASE STUDY OF PARTICULATE EMISSIONS FROM SEMI-SUSPENSION INCINERATION OF MUNICIPAL REFUSE Final Report
W. D. Snowden and Kenneth D. Brooks Nov. 1976 87 p Sponsored by EPA
(PB-262129/0; EPA-910/9-76-033) Avail: NTIS HC A05/MF A01 CSCL 13B

Sampling was conducted at the operating facility of the East Hamilton Solid Waste Reduction Unit, Hamilton, Ontario. Based upon three runs of EPA Method 5, the No. 1 boiler and electrostatic precipitator at the subject facility emitted 0.528 grains per dry standard cubic foot, corrected to 12% carbon dioxide. GRA

N77-22707# California Univ., Davis. Crocker Nuclear Lab.
APPLICATION OF ALPHA SCATTERING FOR ON-LINE ANALYSIS OF LIGHT ELEMENTS IN AEROSOLS Final Report
Thomas A. Cahill 30 Sep. 1976 47 p refs
(Grant NSF AEN-74-24369)
(PB-261915/3; UCD-CNL-166; NSF/RA-760384) Avail: NTIS HC A03/MF A01 CSCL 14B

Ion scattering analysis has been developed to be compatible with ion-excited X-ray analysis so that, in a single analytical run, any element from hydrogen through uranium can be observed, and in principle identified, if present above the minimum detectable limits. The technique is most directly useful in studies of atmospheric aerosols, especially with emphasis on visibility reduction, although other uses are being investigated. The most obvious limitation of the technique is that since all elements are observable, the sample substrate will always be seen, limiting sensitivity for several elements. GRA

N77-22708# IIT Research Inst., Chicago, Ill.
SAMPLING INTERFACE FOR THE QUANTITATIVE TRANSPORT OF AEROSOLS: FIELD PROTOTYPE Final Report
Madhav B. Ranade Jun. 1976 71 p
(Contract EPA-68-02-1295)
(PB-262201/7; EPA-600/2-76-157) Avail: NTIS HC A04/MF A01 CSCL 14B

A sampling interface for the quantitative transport of aerosols was designed, fabricated and evaluated. The interface may be used for transporting particles (up to 50 micrometers in diameter) from industrial stacks to a collection device or a monitoring instrument. The interface consists of a porous wall probe with clean air transpiring inwards to prevent deposition of particles. Laboratory and field testing of the interface has shown it to be efficient in transporting particles encountered in industrial stacks. GRA

N77-22709# Tennessee Univ., Knoxville. Water Resources Research Center.
THERMAL EFFECTS ON BIODEGRADATION OF POLLUTANTS IN WATER
C. George Hollis 3 Dec. 1976 32 p refs Sponsored by Office of Water Res. and Technol. Prepared in cooperation with Memphis State Univ., Tenn.
(PB-261512/8; W77-02218; OWRT-A-037-TENN(1); RR-53) Avail: NTIS HC A03/MF A01 CSCL 13B

Biodegradation was enhanced by acclimatizing the sewage seed to LAS (Linear Alkyl Sulfonate) when compared to using unacclimatized seed and seed acclimatized to temperature only. Carbon chain degradation, sulfate removal and benzene ring opening of the LAS molecule were somewhat simultaneous and were influenced by incubation temperatures. The presence of glucose in the reaction mixture retarded the rate of LAS carbon chain biodegradation. The data suggest thermal pollution would increase the rate by which trace amounts of biodegradable organic compounds, such as LAS, would be degraded in water. GRA

N77-22710# Tennessee Univ., Knoxville. Water Resources Research Center.
MATHEMATICAL MODELING FOR WATER QUALITY MANAGEMENT IN STREAMS UNDER UNSTEADY HYDRAULIC CONDITIONS
Donald E. Overton and Michael E. Meadows 26 Oct. 1976 131 p refs
(Contract DI-14-31-0001-5034)
(PB-261240/6; W77-01946; OWRT-A-036-TENN(1); RR-55) Avail: NTIS HC A07/MF A01 CSCL 13B

A one dimensional model describing the stream dissolved oxygen levels in time and space has been developed that is valid for any combination of steady and unsteady organic waste inputs and streamflow conditions. This model was formulated in terms of the principal source and sink for dissolved oxygen, atmospheric reaeration and biochemical oxygen demand, respectively. Additional sources and sinks may be combined linearly when appropriate. The unsteady hydraulics are described by the unsteady streamflow equations which are solved simultaneously with the coupled equations for dissolved oxygen. Solution of these four partial differential equations is best obtained through numerical integration techniques. GRA

N77-22711# Polytechnic Inst. of New York, Brooklyn.
CORRELATION OF MATHEMATICAL MODELS FOR WATER TEMPERATURE WITH AERIAL INFRARED WATER TEMPERATURE SURVEYS
J. C. Cataldo, R. R. Zavesky, and A. S. Goodman Dec. 1976 70 p refs Sponsored by New York State Energy Res. and Develop. Authority
(PB-261579/7; NYSERDA-75/19) Avail: NTIS HC A04/MF A01 CSCL 13B

A phenomenological model based on field measurements of heated surface discharges into Lake Michigan and Ontario and an analytic dispersion-type far field model were investigated. A predictive model was developed for phenomenological relationships for surface areas within isotherms. A series of exponential equations relating the surface area to the subsurface area was formulated which can predict subsurface temperatures within 1 C to at least ten feet below the surface. A far field hydrothermal analytic model considering longitudinal

advection and dispersion in the transverse and vertical direction was also developed. GRA

N77-22712# Alaska Univ., College. Inst. of Marine Science.
THE ARCTIC COASTAL ENVIRONMENT OF ALASKA. VOLUME 2: A COMPILATION AND REVIEW OF SCIENTIFIC LITERATURE OF THE ARCTIC MARINE ENVIRONMENT
H. M. Feder, D. G. Shaw, and A. S. Naidu May 1976 203 p refs
(Grant NOAA-04-5-158-35)
(PB-261993/0; IMS-R76-5-Vol-2; Sea-Grant-76-9-Vol-2; NOAA-76111020-Vol-2) Avail: NTIS HC A10/MF A01 CSCL 13B

Scientific literature of the Arctic marine environment is reviewed. This reference, for convience of the user, is divided into eleven chapters as follows: physical oceanography; chemical and geological oceanography, plankton, benthic algae, general ecological and biological studies, ice algae, benthic microalgae and primary production, benthic invertebrates, fishes, marine birds and mammals, environmental impact and oil pollution, and environmental effects of an oil spill at Prudhoe Bay. Each chapter consists of a short narrative reviewing key literature. GRA

N77-22713# Argonne National Lab., Ill. Energy and Environmental Systems Div.
PRIORITIES AND PROCEDURES FOR DEVELOPMENT OF STANDARDS OF PERFORMANCE FOR NEW STATIONARY SOURCES OF ATMOSPHERIC EMISSIONS Final Report
Loren J. Habegger, Richard R. Cirillo, and Norman F. Sather May 1976 216 p refs Sponsored by EPA
(PB-261803/1; EPA-450/3-76-020) Avail: NTIS HC A10/MF A01 CSCL 13B

A methodology that has been developed for selecting priorities and schedules based on projected reductions in emissions resulting from the individual standards and other considerations related to technological, legal, institutional, and conservation factors was developed. The methodology is used with available data to develop an initial standard-setting program. The program variations that result from alternate areas of emphasis are also presented. GRA

N77-22714# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
AEROS MANUAL, VOLUME 5. UPDATE NUMBER 1
Nov. 1976 32 p
(PB-262343/7; EPA-450/2-76-005-1-Vol-5; OAQPS-1.2-042-1-Vol-5) Avail: NTIS HC A03/MF A01 CSCL 13B

Update No. 1 to AEROS Manual of Codes, Volume 5, contains a revised table of contents along with sections on Volume 5 Updates, general geographical codes, NEDS specific codes and SAROAD specific codes. GRA

N77-22715# Environmental Sciences Research Lab., Research Triangle Park, N.C. Meteorology and Assessment Div.
URBAN AIR POLLUTION MODELING WITHOUT COMPUTATION
Michael M. Benarie Nov. 1976 83 p refs
(PB-262393/2; EPA-600/4-76-055) Avail: NTIS HC A05/MF A01 CSCL 13B

Some specific topics are the limits set by atmospheric predictability, forecasting pollution concentrations in real time as for pollution episodes, and the simple box model for pollution cencentrations. The frequency distribution of concentration values including the log-normal distribution and averaging-time analysis, the relationships between wind speed and concentration, and lastly the critical question of model validation and the need to consider several indices of goodness-of-fit are discussed. GRA

N77-22716# Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering.
HYDROLOGIC SIMULATION USING DISTRIBUTED PARAMETERS
L. F. Huggins, T. H. Podmore, and C. F. Hood 1976 63 p refs Sponsored in part by Dept. of Interior
(Grant NSF GV-28455)
(PB-262078/9; TR-82; W77-03001; OWRT-A-027-IND(2)) Avail: NTIS HC A04/MF A01 CSCL 13B

The distributed watershed model developed was based upon the premise that a watershed could be subdivided into a grid of square elements each sufficiently small in size that all hydrologically significant factors would be uniform within its boundaries. A laboratory flow table was constructed which provided simulated rainfall and overland flow on full-scale watershed elements representative of various surfaces. This apparatus was used to study flow over three uniformly rough surfaces created from various sand and gravel-sized particles. GRA

N77-22717# California Univ., Riverside. Statewide Air Pollution Research Center.
BEHAVIOR OF H2S IN THE ATMOSPHERE AND ITS EFFECTS ON VEGETATION Annual Report, 1 May 1975 - 30 Apr. 1976
C. Ray Thompson 1976 20 p
(PB-262733/9; NSF/RA-760398) Avail: NTIS HC A02/MF A01 CSCL 13B

The concurrent ongoing studies of effects of H2S on vegetation were begun by exposing four species to H2S at successive levels continuously. Within five days, leaf lesions appear on the alfalfa in the 3,000 ppb exposure. Reduced growth is seen in subsequent exposures. The immediate effect of H2S at the 3,000 ppb on grapes is similar to that on alfalfa, but, lower levels produce lesser effects. The buckeye is quite resistant to the effects of H2S, but it proves to be a poor choice because of the variability of its response to the environment. It is much more resistant to H2S than alfalfa or grapes, and the pines accumulate much less sulfur than the other species, and prove to be relatively resistant. GRA

N77-22718# Missouri Water Resources Research Center, Columbia.
FECAL COLIFORM ANALYSIS: EFFECTS OF ELEVATED TEMPERATURES ON QUANTITATIVE RECOVERY
James B. Hufham, Barbara Patterson, and Jana Podzimek 12 Oct. 1976 13 p refs
(Contract DI-14-34-0001-6026)
(PB-261361/0; W77-02182; OWRT-A-089-MO(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

Recoveries of known densities of pure cultures of E. coli varied from 10 to 70 percent from the type of membrane filter. Results show that the interaction of the membrane with the cell, resulting in loss of cell viability, is temperature dependent and varies from brand to brand. A modified fecal coliform procedure was developed and field tested. This new procedure lessens the detrimental effects of the temperature on recovery of the organism. GRA

N77-22719# Nebraska Univ., Lincoln. Dept. of Electrical Engineering.
INVESTIGATION OF LASER RAMAN SPECTROSCOPY FOR ANALYSIS OF WATER QUALITY
Frank G. Ullman and Bruce W. Jones Jun. 1976 25 p refs
(Contract DI-14-34-0001-6029)
(PB-261238/0; W77-01817; OWRT-A-035-NEB(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

Lower limits for the detection of nitrates and sulfates in distilled water were determined to be 20 ppm and 8.5 ppm respectively. The herbicides atrazine, picloram, trifluoralin, amiben and dicamba were also investigated. Atrazine was detected down to 750 ppm. Trifluoralin absorbed most of the incident light at the two laser frequencies so a spectrum was not obtained, and the spectra of the other herbicides were obscured by their own fluorescence. GRA

N77-22720# Oregon State Univ., Corvallis. Water Resources Research Inst.
A ROTATING FLIGHTED CYLINDER FOR SOLID-LIQUID SEPARATION AND BIOLOGICAL WASTE TREATMENT Completion Report, 1 Jul. 1974 - 30 Jun. 1976
J. Ronald Miner Sep. 1976 84 p refs Sponsored by Office of Water Res. and Technol.
(PB-261242/2; WRRI-48; W77-01815; OWRT-A-031-ORE(2)) Avail: NTIS HC A05/MF A01 CSCL 13B

A single device for solid-liquid separation and biological waste treatment was designed, built, and evaluated. The device, a rotating

flighted cylinder, consists of a cylindrical tube which has a helically wound fin mounted perpendicular to the interior surface. When mounted at a slight incline (7 to 15 degrees) and slowly rotated (1 to 3 rpm), the device provides a mechanism to accomplish sedimentation between wraps of the fin. The fin surfaces, alternately exposed to the waste and the atmosphere, perform conversion of soluble organic matter to bacterial cells in a manner similar to rotating disk processes. The solid-liquid separation aspect of the device was evaluated with respect to dilute dairy and swine manure slurries. GRA

N77-22721# Battelle Columbus Labs., Ohio.
CHEMICAL AND PHYSICAL CHARACTERIZATION OF AUTOMOTIVE EXHAUST PARTICULATE MATTER IN THE ATMOSPHERE Final Annual Summary Report, Jan. 1975 - Jun. 1975
D. A. Trayser, F. A. Creswick, E. R. Blosser, and D. F. Miller 30 Sep. 1976 127 p refs
(PB-262042/5; CRC-APRAC-CAPE-19-70-5; ASR-6) Avail: NTIS HC A07/MF A01 CSCL 13B

Automotive exhaust particulates in the atmosphere were studied. A monolithic noble metal catalyst equipped car was operated on a chassis dynamometer at various steady speeds (including idle) with particular attention to the effects of preconditioning on sulfate emission rates. The vehicle exhaust was discharged into a dilution tube from which samples were taken for chemical and physical characterization of suspended particles. Particle characterization included total weight, weight of sulfates, size distribution, and light-scattering effects. Measurements of gaseous emission components were also made simultaneously from the vehicle tailpipe and from the dilution tube. GRA

N77-22722# Transportation Research Board, Washington, D.C.
ASSESSING TRANSPORTATION-RELATED AIR QUALITY IMPACTS
1976 206 p refs Conf. Proc. held at Washington, 22-24 Oct. 1975; sponsored by EPA and Federal Highway Admin.
(PB-261196/0; TRB/SR-167; ISBN-0-309-02478-1; LC-76-20621) Avail: NTIS HC A10/MF A01 CSCL 13B

The conference papers on transportation-related air quality impacts are given. These papers give up-to-date information on service in modeling. The first seven papers deal with photochemical oxidant models and the last twelve deal with nonreactive models. GRA

N77-22723# Systems Control, Inc., Palo Alto, Calif.
FLUOROCARBONS AND THE ENVIRONMENT: A PRELIMINARY TECHNOLOGY ASSESSMENT
Richard P. Brennan, Richard W. J. Lau, James W. Patmore, Robert B. Schainker, and Ronald A. Siegel Apr. 1976 152 p refs
(Grant NSF ERP-75-14878)
(PB-261713/2; NSF/RA-760307) Avail: NTIS HC A08/MF A01 CSCL 13B

They are primarily used as propellants in aerosol spray cans, as refrigerants in air conditioning and refrigeration, and as blowing agents in the production of foamed materials. The decision to regulate or not to regulate F-11/F-12 production and its uses must be based upon analyses which involve many uncertain atmospheric and biological processes. To help study this complex problem, a probabilistic computer analysis has been utilized to partially analyze the consequences of alternative decision policies. GRA

N77-22724# Environmental Protection Agency, Research Triangle Park, N.C. Office of Air Quality Planning and Standards.
STATE AIR POLLUTION IMPLEMENTATION PLAN Progress Report, 1 Jan. - 30 Jun. 1976
Oct. 1976 227 p Prepared in cooperation with EPA, Washington, D. C.
(PB-261179/6; EPA-450/2-76-026) Avail: NTIS HC A11/MF A01 CSCL 13B

Data for each state is presented/on the attainment/nonattainment status and calls for revision to the State Implementation Plan (SIPs) by Air Quality Control Region (AQCR) and state portion of interstate AQCRs for all criteria pollutants, status of selected portions of the state implementation plans, resources (manpower and funding), and compliance status of selected source categories. One hundred twenty-four AQCRs or state portions have attained the TSP standard, 256 the SO2 standard, 233 the CO standard, 143 the oxidant standard and 308 the NO2 standard. GRA

N77-22725# Energy Research and Development Administration, Bartlesville, Okla. Bartlesville Energy Research Center.
FUEL CONSUMPTION, EMISSIONS, AND POWER CHARACTERISTICS OF THE 1975 FORD 140-CID AUTOMOTIVE ENGINE, EXPERIMENTAL DATA Interim Report, Feb. - Apr. 1976
W. F. Marshall and K. R. Stamper Nov. 1976 42 p
(Contract DOT-TSC-RA-75-10)
(PB-261771/0; BERC/OP-76/15; DOT-TSC-OST-76-43) Avail: NTIS HC A03/MF A01 CSCL 21G

Experimental data were obtained in dynamometer tests of the 2-bbl engine to determine steady-state fuel consumption and emissions of hydrocarbon, carbon monoxide, and oxides of nitrogen. These data were obtained in detail adequate to construct performance maps for the entire speed/load operating range of the engine. GRA

N77-22726# Florida Univ., Gainesville. Water Resources Research Center.
REMOVAL OF VIRUSES FROM WATER BY MAGNETIC FILTRATION
Gabriel Bitton, George F. Gifford, and Oscar C. Pancorbo Oct. 1976 84 p refs
(Contract DI-14-34-0001-6010)
(PB-261494/9; WRRC-Pub-40; W77-02214; OWRT-A-030-FLA(3)) Avail: NTIS HC A05/MF A01 CSCL 13B

The process of magnetic filtration was applied to the removal of T2 bacteriophage, MS2 bacteriophage, and poliovirus type 1 (Sabin) from water and wastewater. Since the effectiveness of this process is governed by the adsorption of the viruses onto the magnetic iron oxide seed, magnetite, those factors influencing adsorption were investigated. The adsorption of the three viruses studied to magnetite at a concentration of 500 ppm increased in the presence of cations, was not affected when the pH was varied from 5 to 9, and could be described by the Freundlich adsorption isotherm. Viruses were suspended in two wastewater effluents and subsequently removed by magnetic filtration. GRA

N77-22727# Rhode Island Univ., Kingston. Dept. of Mechanical Engineering and Applied Mechanics.
A COMPREHENSIVE SYSTEMS ENGINEERING STUDY OF THE TRUE ECONOMIC VALUE OF UNPOLLUTED WATER VERSUS VARYING DEGREES OF POLLUTED WATER Final Technical Report, 1 Jun. 1974 - 30 Jun. 1975
Charles D. Nash, Jr. 7 Jun. 1976 24 p refs
(Contract DI-14-31-0001-4040)
(PB-261493/1; W77-02220; OWRT-A-057-R(1)) Avail: NTIS HC A02/MF A01 CSCL 13B

True costs associated with water pollution are described. Offset costs are included. Total water pollution cost is specified as including cleanup costs, industrial use costs, recreational use costs, health costs, and esthetic costs. A new concept is introduced of using the offset costs of pollution as a basis for setting tariffs to place competition between domestic and foreign companies on an equal global pollution basis. GRA

N77-22728# Illinois Univ., Chicago. Medical Center.
POPEX - RANKING AIR POLLUTION SOURCES BY POPULATION EXPOSURE
Lyndon R. Babcock, Jr. and Niren L. Madga Mar. 1976 345 p refs
(PB-261458/4; EPA-600/2-76-063) Avail: NTIS HC A15/MF A01 CSCL 06F

Quantitative models were developed for relating emissions of air pollutants to their effects on people, and the methodology was used to determine the relative importance of air pollution sources. The quantitative methodology for ranking the sources includes consideration of the dispersion of air pollutants, exposure of people, and subsequent health effects. The computer model,

called POPEX, consists of three submodels: dispersion, population, and health effects. The model was applied to sources of air pollution in the Chicago Air Quality Control Region. Results show that 17 of 227 categories of sources contribute nearly 80% of the total air-pollution/population-effect problem. GRA

N77-22729# Ohio State Univ., Columbus. Water Resources Center.

TRACE METAL DETECTION IN AQUATIC ENVIRONMENTS BY ACTIVATION ANALYSIS OF NAIAD SHELLS Completion Report

Walter E. Carey Jul. 1976 54 p refs Sponsored by Dept. of Interior

(PB-261262/0; Rept-442x; W77-01820; OWRT-A-028-OHIO(1)) Avail: NTIS HC A04/MF A01 CSCL 08A

The feasibility of using neutron activation analysis of aquatic mollusk shells to measure quantities of trace metals in water was reviewed. A generalized approach to estimating the sensitivity of a particular metal/irradiation facility/essay system was developed. Radiation hazard to both activation analysts and subsequent users of irradiated museum specimens was investigated and found to be minimal. A sample preparation technique was developed to separate annual shell layers. Three species of naiads were used to determine that there is no significant species effect on the concentration in the shell of the four elements investigated. GRA

N77-22730# General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.

MONITORING GROUNDWATER QUALITY: ECONOMIC FRAMEWORK AND PRINCIPLES

Robert L. Crouch, Ross D. Eckert, and Donald D. Rugg Sep. 1976 107 p refs

(Contract EPA-68-01-0759)

(PB-260919/6; GE75TMP-71; EPA-600/4-76-045) Avail: NTIS HC A06/MF A01 CSCL 08H

Section I argues that poor specification of the property rights in groundwater is a major cause of excessive pollution. Section II examines groundwater adjudication and legislation and notes that government intervention through the authority will take place in the form of government established and enforced groundwater quality standards. Section III discusses the overall costs and benefits to society involved in groundwater quality monitoring. Section IV discusses monitoring needs for establishment of quality standards and their enforcement, and develops a cost-benefit framework for the analysis of groundwater quality monitoring. Section V examines an alternative regulatory approach based on 'waste relocation rights' for property owners. GRA

N77-22731# Calspan Corp., Buffalo, N.Y.

SULFUR DIOXIDE PHOTOOXIDATION RATES AND AEROSOL FORMATION MECHANISMS. A SMOG CHAMBER STUDY Final Report

W. C. Kocmond Aug. 1976 89 p refs

(Contract EPA-68-02-1231)

(PB-260910/5; EPA-600/3-76-090; CALSPAN-NA-5365-M-3) Avail: NTIS HC A05/MF A01 CSCL 07E

Tasks were performed on various systems ranging from HC + nitrogen oxide + SO2 to clean air + SO2 mix. Emphasis was placed on the rates of SO2 photooxidation and on chemical characterization of aerosol products. Results were interpreted to suggest that the major SO2 oxidation process is the reaction of sulfur dioxide with OH radicals. Other findings are reported.GRA

N77-22732# Bureau of Mines, Washington, D.C.

SIZE DISTRIBUTION AND MASS OUTPUT OF PARTICULATES FROM DIESEL ENGINE EXHAUSTS Report of investigations 1976

John A. Breslin, Anthony J. Strazisar, and Richard L. Stein Oct. 1976 16 p refs

(PB-261416/2; BM-RI-8141R) Avail: NTIS HC A02/MF A01 CSCL 13B

Samples were taken from the exhaust of two types of engines using three types of fuel. The measured mass median diameters of the diesel particulates were typically about 0.3 micrometer. Concentration measurements ranged from 14.2 to 250.9 mg/cu m and calculated mass outputs from 64 to 10,000 mg/min. Significant differences in mass output were found between engines, fuels, and especially between different operating modes. The quantity of clean dilution air which would be required to reduce the particulate mass concentration below the 2.0 mg/cu m respirable dust standard for coal mines was greater than the dilution air required to meet the standards for noxious gases for both engines tested. GRA

N77-22733# Environics, Inc., Newport Beach, Calif.

CATALYTIC REDUCTION OF NITROGEN OXIDES WITH AMMONIA: UTILITY PILOT PLANT OPERATION Final Report, Jan. 1973 - Oct. 1976

Jules M. Kline, Paul H. Owen, and Y. C. Lee Oct. 1976 94 p

(Contract EPA-68-02-0292)

(PB-261265/3; EPA-600/7-76-031) Avail: NTIS HC A05/MF A01 CSCL 13B

Work to demonstrate, on a utility pilot plant scale, the performance, reliability, and precticability of reducing nitrogen oxides (NOx) emissions from steam boilers by reduction of NOx with ammonia over a platinum catalyst is described. A utility pilot plant treating a slip stream from an operating electric utility boiler, equivalent to approximately 1.5 MW output, was designed installed, and tested on gas and oil fuel. Laboratory pilot plant testing supplemented the utility pilot plant testing. Results of gas-firing the utility pilot plant, together with laboratory pilot plant test results, indicated that the catalytic reduction system has consistently provided 85 to 90% NOx removal for over 4,000 hours, with no significant performance loss at a 50,000 per hour space velocity. GRA

N77-22734# Environmental Protection Agency, Cincinnati, Ohio.

CHEMICAL ANALYSES FOR WATER POLLUTANTS

Audrey E. Kroner Nov. 1976 154 p refs

(PB-261260/4; EPA-430/1-75-013) Avail: NTIS HC A08/MF A01 CSCL 13B

The contents concern individual constituents found in water (e.g. dissolved oxygen) and information useful to analysts (e.g. statistics). A section of laboratory procedures adapted for class groups is included. GRA

N77-22735# Louisiana State Univ., Baton Rouge. Coastal Studies Inst.

ATMOSPHERIC DISPERSION CHARACTERISTICS IN COASTAL ENVIRONMENTS

S. A. Hsu Dec. 1976 18 p refs Presented at the 3d Intern. Ocean Development Conf., Tokyo, 5-8 Aug. 1975

(Contract N00014-69-A-0211-0003; NR Proj. 388-002)

(AD-A033505; TR-224) Avail: NTIS HC A02/MF A01 CSCL 06/6

Proposed construction of offshore facilities such as nuclear-power plants, airports, and other structures which are potential emitters of pollutants necessitates consideration of atmospheric diffusion and analysis of the feasibility of such structures from the meteorological point of view. The potentially harmful nature of the radioactive materials involved dictates that even small quantities be treated with respect. Special attention must be given to design criteria in locations where hurricanes (typhoons), storm surges, tsunamis, waterspouts, or other catastrophic meteorological and oceanographic phenomena may occur. The movement of air pollutants is governed primarily by wind systems. In coastal zones influenced by land- and sea-breeze systems, at least two inversion layers exist: the mesoscale subsidence inversion and inversion associated with the internal boundary layer. Thus, from an air-pollution point of view, there is no advantage to locating a power plant or similar structure offshore because on-shore airflow will bring the pollutants to the coast. There are some areas along continental and island coasts which may be suitable for power plant or airport location. Major criteria are the following: (1) Offshore winds should be prevalent during most of the year, particularly during the summer; (2) the upwind coastal region should be relatively flat in order to avoid a mesoscale turbulent vortex; (3) offshore bottom slope should be gentle and bathymetrically uniform to attenuate storm surges and minimize wave effects. GRA

N77-22736# Air Force Geophysics Lab., Hanscom AFB, Mass. Meteorology Div.

THE AIR QUALITY AND NOISE IMPACT OF A WARM FOG

DISPERSAL SYSTEM USING MOMENTUM DRIVEN HEAT SOURCES
Bruce A. Kunkel 1 Sep. 1976 22 p refs
(AF Proj. 2093)
(AD-A033623; AFGL-TR-76-0199; AFGL-AFSG-351) Avail: NTIS HC A02/MF A01 CSCL 13/2

The impact of a Warm Fog Dispersal System (WFDS) on the air quality and noise level is assessed. The WFDS, designed by AFGL, uses various combinations of heat and thrust to disperse the fog over the runway and approach zones. Emission and noise levels that are within the state-of-the-art are used in this assessment. Calculations show that within the cleared area the pollution concentrations, on the average, are within the EPA standards. Author (GRA)

N77-22737# Naval Surface Weapons Center, White Oak, Md.
DEFENSE TECHNOLOGY FOR ENVIRONMENTAL PROTECTION. VOLUME 2: BIBLIOGRAPHY Final Report, Sep. 1973 - Jun. 1975
Eldon A. Byrd, O. M. Meredith, and Sherman Gee Mar. 1976 244 p refs Sponsored by EPA
(AD-A032564; NSWC/WOL/TR-75-111-Vol-2; EPA-600/2-76-068b) Avail: NTIS HC A11/MF A01 CSCL 13/2

The report condenses an effort design to identify and transfer significant technology concerned with air pollution monitoring and control from the Department of Defense (DOD) to the EPA. Included are technology profiles of each DOD laboratory involved in particular work of interest to EPA's Industrial Environmental Research Laboratory-RTP, a bibliography of pertinent DOD documentation, and a description and assessment of how the study was conducted. Author (GRA)

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation*.

N77-22738 Oregon State Univ., Corvallis.
STATISTICS OF SPECKLE PROPAGATION THROUGH THE TURBULENT ATMOSPHERE Ph.D. Thesis
Myung Hun Lee 1976 72 p
Avail: Univ. Microfilms Order No. 77-6075

The analysis of the first and second-order statistics of received irradiance of a single mode laser beam after scattering from the diffuse target is presented. The technique is based upon the extended Huygens-Fresnel formulation and includes the effects of the turbulent atmosphere on the laser beam as it propagates back to the receiver. Formulation have been developed for both the focused and collimated cases. It is first assumed in the analysis that phase perturbation of spherical wave is the dominant effect due to the atmosphere. Utilizing this assumption, it is shown that the fields at the receiver are Gaussian and that the space-averaged, spatial power spectral density at the receiver is white. Based on these results, it is assumed that the field statistics at the receiver are jointly Gaussian. The conditions for validity of the jointly Gaussian assumption are discussed and an analysis of the near received irradiance in the presence of glints (specular reflector) is presented using the phase dominance assumption. Dissert. Abstr.

N77-22739*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
ASSESSMENT OF GEOPHYSICAL FLOWS FOR ZERO-GRAVITY SIMULATION Final Report
C. Byron Winn, Andrew Cox, and R. Srivatsangam Dec. 1976 89 p refs
(Contract NAS8-31347)
(NASA-CR-150242) Avail: NTIS HC A05/MF A01 CSCL 20D

The results of research relating to the feasibility of using a low gravity environment to model geophysical flows are presented. Atmospheric and solid earth flows are considered. Possible experiments and their required apparatus are suggested. Author

N77-22740*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETECTION OF ALTERATION ASSOCIATED WITH A PORPHYRY COPPER DEPOSIT IN SOUTHERN ARIZONA
M. J. Abrams and B. S. Siegal 1 Feb. 1977 10 p
(Contract NAS7-100)
(NASA-CR-152677; JPL-TM-33-810) Avail: NTIS HC A02/MF A01 CSCL 08G

Computer processing of Landsat MSS data was performed using contrast stretching and band-to-band ratioing. A false color ratio composite picture showed color anomalies which coincided with known areas of alteration on and about Red Mountain. A helicopter survey of the study area was undertaken using a portable field reflectance spectrometer. One hundred fifty-six spectra were obtained in the 0.4 to 2.5 micrometer wavelength region. The spectra were digitized, and contour maps for 24 wavelength intervals were produced; no spectral anomalies were evident for the known altered areas. A contour map produced from the 1.6 and 2.2 micrometer ratio generally delineated the alteration areas. The 1.3, 1.6, and 2.2 micrometer wavelength data were canonically transformed using a transformation empirically derived from discriminant function analysis of altered and unaltered materials for the Goldfield, Nevada region, and a contour map was produced for the first canonical variable. The known areas of alteration were clearly defined on the contour map. Author

N77-22741*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS OF AEROSPACE TECHNOLOGY TO PETROLEUM EXPLORATION. VOLUME 1: EFFORTS AND RESULTS
Leonard D. Jaffe 30 Sep. 1976 145 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-152694; JPL-Doc-5040-32-Vol-1) Avail: NTIS HC A07/MF A01 CSCL 08G

The feasibility of applying aerospace techniques to help solve significant problems in petroleum exploration is studied. Through contacts with petroleum industry and petroleum service industry, important petroleum exploration problems were identified. For each problem, areas of aerospace technology that might aid in its solution were also identified where possible. Topics selected for investigation include: seismic reflection systems; down-hole acoustic techniques; identification of geological analogies; drilling methods; remote geological sensing; and sea floor imaging and mapping. Specific areas of aerospace technology are applied to 21 concepts formulated from the topics of concern. Author

N77-22742*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS OF AEROSPACE TECHNOLOGY TO PETROLEUM EXPLORATION. VOLUME 2: APPENDICES
Leonard D. Jaffe 30 Sep. 1976 296 p refs 2 Vol.
(Contract NAS7-100)
(NASA-CR-152693; JPL-Doc-5040-32-Vol-2) Avail: NTIS HC A13/MF A01 CSCL 08G

Participants in the investigation of problem areas in oil exploration are listed and the data acquisition methods used to determine categories to be studied are described. Specific aerospace techniques applicable to the tasks identified are explained and their costs evaluated. A.R.H.

N77-22743# Colorado Univ., Boulder. Dept. of Geological Sciences.
EXPERIMENTAL DEFORMATION OF PIERRE SHALE Final Report, 1 Jan. 1972 - 30 Jan. 1976
W. A. Braddock and M. Machette Mar. 1976 101 p refs
(Contract F19628-72-C-0153)
(AD-A025275; AFGL-TR-76-0086) Avail: NTIS HC A06/MF A01 CSCL 08/7

The strength, mode of deformation, and induced pore pressure effects of Pierre Shale were partially investigated at 20 C, and at confining pressures to 2 Kb. All tests were performed on cylindrical samples in which bedding was parallel to the axis of maximum compression. The strength in unconsolidated-undrained compression tests ranged from 60 to 150 bars and increased only slightly with confining pressure, because the effective confining pressure remained near zero. The strength increased significantly with increase of effective confining pressure. The strength decreased about 2 to 4 percent per decade of decrease in strain rate. Author

N77-22744# Naval Surface Weapons Center, Dahlgren, Va.
A GRAVITATIONAL POTENTIAL FOR ATMOSPHERIC EARTH TIDES CAUSED BY THE SUN
Walter Groeger Oct. 1976 22 p refs
(AD-A031409; NSWC/DL-TR-3485) Avail: NTIS HC A02/MF A01 CSCL 22/3

A potential function is presented for the force by which the atmospheric tide bulge acts on the orbits of artificial earth satellites. The tidal bulge is assumed to be caused by the combined effect of solar heating and solar mass attraction. The semidiurnal term as well as the diurnal term are considered. The potential is intended for use with computer programs for satellite geodesy. GRA

N77-22745# Naval Civil Engineering Lab., Port Hueneme, Calif.
AN EARTHQUAKE ANALYSIS OF THE LIQUEFACTION POTENTIAL AT THE NAVAL AIR STATION, NORTH ISLAND Final Report, Jul. 1974 - Aug. 1975
J. B. Forrest and J. M. Ferritto Sep. 1976 68 p refs
(AD-A033493; CEL-TR-847) Avail: NTIS HC A04/MF A01 CSCL 08/11

The loss of strength experienced by saturated cohesionless soils during earthquake or shock loading is generally referred to as liquefaction. The hazard potential existing at Naval Air Station, North Island, California, due to this phenomenon is evaluated herein, including both a statistical evaluation of potential earthquake levels and an appraisal of the magnitudes of damage. Knowledge of the in-situ soils was used in conjunction with earthquake-response predictions in the most recent state-of-the-art prediction procedures. Problems encountered in making liquefaction evaluations are discussed in some detail. These problems include predicting the magnitude and recurrence rates (frequency) of ground motions to be expected, determining the true nature of the subsurface soils, and finally evaluating the effect of the applied ground motions on these subsurface soils. This report concludes that although most of North Island is underlain by natural sands which should be fairly resistant to liquefaction, limited regions with very high liquefaction potential exist. These regions would be expected to liquefy under earthquake levels used for engineering analysis, and present a high damage potential to such critical structures as the carrier docking facilities, aviation fuel tank farms, and service lines. Author (GRA)

N77-22746# Weidlinger Associates, New York.
MATERIAL MODELING BASED ON CIST TEST AND LABORATORY DATA Final Report, Feb. 1975 - Jan. 1976
I. S. Sandler 31 Mar. 1976 64 p refs
(Contract DNA001-75-C-0239)
(AD-A033233; DNA-3970F) Avail: NTIS HC A04/MF A01 CSCL 08/11

An iterative procedure is presented for constructing mathematical constitutive models for use in ground shock calculations. The procedure uses both laboratory and in situ (CIST) data for modeling. An original cap model based on laboratory data is adjusted in such a way as to achieve agreement between CIST measurements and a numerical computation of the CIST experiment using the model. The final model which results can then be used to represent the site for other ground shock calculations. Author (GRA)

N77-22747# National Oceanic and Atmospheric Administration, Idaho Falls, Idaho. Air Resources Labs.
DIFFUSION UNDER LOW WINDSPEED CONDITIONS NEAR OAK RIDGE, TENNESSEE
R. B. Wilson, G. E. Start, C. R. Dickson, and N. R. Ricks Aug. 1976 88 p refs Sponsored by NOAA
(Contract AT(49-5)-1289)
(PB-262460/9; NOAA-TM-ERL-ARL-61; NOAA-76112407) Avail: NTIS HC A05/MF A01 CSCL 04A

A series of controlled gaseous tracer releases was conducted to study terrain effects on atmospheric dispersion, under low wind speeds, and neutral to moderately stable conditions. Analyses of aerial and ground level samplings of sulfur hexafluoride and dibromodifluoromethane gaseous tracers used an electron capture gas chromatograph. In comparisons of sampled tracer concentration measurements with Pasquill's predicted values for flat terrain all of the observed axial concentrations were less than those predicted by the Pasquill-Gifford curves for the appropriate stability classes. The standard deviation of lateral plume spread averaged 6.0 times greater than predicted values. This increase is attributable mainly to wind meander. The derived vertical plume spread statistic averaged 5.7 times greater than Pasquill-Gifford predicted values. Roughness of the surface (vegetation and topography) enhanced the vertical diffusion.GRA

N77-22748# Illinois Univ., Urbana-Champaign. Ionosphere Radio Lab.
SIMULATION AND MEASUREMENT OF THE PLASMASPHERIC ELECTRON CONTENT Final Report, 1 Oct. 1974 - 30 Sep. 1976
D. A. Poletti-Liuzzi, K. C. Yeh, and C. H. Liu Sep. 1976 118 p refs
(Contract F19628-74-C-0044; Grant NOAA-04-5-022-10)
(PB-262457/5; UILU-ENG-76-2554; NOAA-76112907; TR-57) Avail: NTIS HC A06/MF A01 CSCL 04A

Computer simulations investigating the sensitivity of the techniques to different ionospheric models are carried out and discussed. The equipment contribution and effects to the measurements are also investigated. Results of the measured plasmaspheric content under normal geomagnetic conditions and during magnetic storms are presented. The possible causes of the observed behavior are also presented. GRA

N77-22749# California Univ., Riverside. Inst. of Geophysics and Planetary Physics.
TELLURIC ANOMALIES CAUSED BY SHALLOW STRUCTURES: ELLIPSOIDAL APPROXIMATIONS
Tien-Chang Lee 1975 23 p refs
(Grant NSF AER-72-03551)
(PB-261508/6; IGPP-UCR-75-18; NSF/RA/N-75-331) Avail: NTIS HC A02/MF A01 CSCL 08G

An analytical solution for the electric field near an ellipsoid immersed in a semi-infinite medium is obtained to estimate the effect of shallow structures on telluric measurements. The determinant J of the Jacobian which transforms telluric field from base to roving stations may change across the boundary of different media by a factor equal to their resistivity ratio. At distances beyond one length of the intermediate axis from the edge of the ellipsoid, both the J-anomaly and the polarization of the normalized telluric field become negligible. GRA

N77-22750# California Univ., Berkeley. Dept. of Materials Science and Engineering.
USE OF ELECTRICAL METHODS FOR THE DELINEATION OF GEOTHERMAL RESERVOIRS Final Report
F. Morrison Sep. 1975 40 p
(Grant NSF GI-37905)
(PB-261507/8; NSF/RA/N-75-336) Avail: NTIS HC A03/MF A01 CSCL 08G

Two areas in Nevada (Buffalo Valley and Beowawe) were selected because they represented typical geothermal areas of the central basin and range province, and afforded easy access for geophysical surveys. A brief description of the electrical methods used is presented in this study. Details of some of the equipment developed are included as appendixes. Results of the research indicate the importance of using some form of reconnaissance mapping. The simple E-field ratio technique is effective and compares favorably with the bipole-dipole resistivity mapping technique at less expense. GRA

N77-22751# Naval Research Lab., Washington, D. C.
CALCULATION OF THE IONOSPHERIC PHOTOELECTRON DISTRIBUTION FUNCTION
Elaine S. Oran and D. J. Strickland Sep. 1976 55 p refs
(AD-A031562; NRL-MR-336) Avail: NTIS HC A04/MF A01 CSCL 04/1

Calculations of the photoelectron flux in the ionosphere have been obtained by solving the Boltzmann equation. The method is flexible enough to allow for a wide range of energy and angular dependences for both external and internal electron sources. Detailed comparisons of calculated and measured photoelectron fluxes show excellent agreement. A series of solutions is shown which indicates the sensitivity of the calculations to the solar zenith angle, isotropic versus forward peaked elastic scattering, and resolution of the energy and angular grids. At altitudes above 300 km, the assumption of forward

peaked scattering gives significantly greater anisotropies in the calculated flux. To determine grid sensitivity, results are obtained for energy grids containing 50 and 20 points between 2 and 90 ev and for angular grids containing 20, 10, and 4 points. Grids which are too coarse can lead to overall errors in the fluxes of a factor of two or larger. Author (GRA)

N77-22752# Litton Systems, Inc., Woodland Hills, Calif. Guidance and Control Systems Div.

POST-MISSION SMOOTHING AND ANALYSIS OF THE MEASUREMENTS OF THE CHANGE IN THE DEFLECTION OF THE VERTICAL OBTAINED BY THE RAPID GEODETIC SURVEY SYSTEM (RGSS) AT THE WHITE SANDS TEST RANGE

James R. Huddle and Richard H. Lentz Sep. 1976 349 p (Contract DAAG53-75-C-0248)

(AD-A032525; ETL-0065) Avail: NTIS HC A15/MF A01 CSCL 08/5

The objectives of this report were: (1) to apply off-line post-mission smoothing to raw real-time estimates of the changes in the deflection of the vertical as collected by the Rapid Geodetic Survey System (RGSS) at White Sands; (2) to analyze the residual errors in the smoothed estimates of the changes in the deflection of the vertical for those runs where reference change information was available to determine significant sources of estimate degradation; and (3) to recommend a further course of action as a result of this analysis which should lead to improvement in the deflection recovery accuracy of the RGSS. Author (GRA)

N77-22753# Tel-Aviv Univ. (Israel). Dept. of Geophysics and Planetary Sciences.

EXPERIMENTAL AND THEORETICAL INVESTIGATION OF THE COALESCENCE OF WATER DROPS Final Technical Report, Oct. 1975 - Jun. 1976

Zev Levin, Benjamin Machnes, and Nitza Arbel May 1976 110 p refs

(Grant DA-ERO-124-74-G-0058; DA Proj. 2M0-61103-B-53B) (AD-A032010) Avail: NTIS HC A06/MF A01 CSCL 04/1

This report summarizes results of the coalscence efficiency of colliding drops which were obtained from laboratory experiments and a theoretical model. Both theory and experiment suggest that the coalescence efficiency is a function of both drop radii and drop size ratio. Even though no clear dependence of coalescence efficiency on impact speed was observed experimentally, the theory does predict some dependence on velocity. Generally it is observed that the coalescence efficiency decreases with increase in the size of the large drop, R(L), and the drop size ratio, p. However, for small R(L) a decrease in the efficiency was also shown. Both theory and experiment demonstrate the strong dependence of coalescence on impact angle. From the experiments, two empirical equations were obtained which relate the coalescence efficiencies and partial coalescence efficiencies with p and R(L). These could be used in numerical models of cloud and rain development. Author (GRA)

N77-22754# Naval Research Lab., Washington, D. C. Space Science Div.

AN AURORAL IONOSPHERIC INVESTIGATION: A PRELIMINARY REPORT ON ELECTRON DENSITY PROFILES

E. P. Szuszczewicz and J. C. Holmes Nov. 1976 21 p refs (NRL Proj. A02-11)

(AD-A033273; NRL-MR-3425) Avail: NTIS HC A02/MF A01 CSCL 04/1

This is the first in a series of reports with the results of a major NASA program coordinating rocket, balloon, and ground-base auroral studies at Poker Flat, Alaska. The program, carrying the code name AURORozone, was designed to study the effects of energetic particle precipitation on the ionosphere and the coupling of particle energy to lower altitudes through X-ray bremmstrahlung radiation. The interest in lower altitude effects focused on changes in ozone, electrical conductivity and temperature. This initial report presents the preliminary findings on the ionospheric plasma state in the 60-230 km region as determined by the Naval Research Laboratory's pulsed plasma probe experiment carried on the Nike-Tomahawk payloads. GRA

N77-22755# Army Electronics Command, Fort Monmouth, N.J.

ANOTHER METHOD FOR ESTIMATING CLEAR COLUMN RADIANCES

Louis D. Duncan and Mary Ann Seagraves Oct. 1976 21 p refs

(AD-A033278; ECOM-5803) Avail: NTIS HC A02/MF A01 CSCL 04/1

An algorithm for estimating clear column radiances from an array of satellite observations is presented. The procedure is iterative and uses the principles of editing about a least squares planar estimate. Examples of data processed by using this technique are given. Author (GRA)

N77-22756# Naval Research Lab., Washington, D. C.

COMPUTER CODES FOR USE IN DISPLAY OF PREDICTED SCINTILLATION CHARACTERISTICS AND TOTAL ELECTRON CONTENT

John M. Goodman and Chauncey Myers Oct. 1976 90 p refs

(AD-A033465; NRL-MR-3397) Avail: NTIS HC A05/MF A01 CSCL 04/1

The Global personality of radiowave characteristics such as amplitude scintillation S4 and group path delay may be graphically displayed through use of a plotting code in conjunction with existing scintillation and electron density models. The Fremouw-Rino-Pope model is used for deducing average scintillation attributes and the Ching-Chiu Model is used for deducing average electron density. The former model is used directly and the latter model is integrated to obtain the total electron content of the ionosphere. Since the total electron content (TEC) is proportional to the group path delay, plots of TEC are provided in the manuscript instead of the delay characteristic. Examples of both S4 and TEC are given for various environmental, diurnal, and seasonal conditions. GRA

N77-22757# Naval Research Lab., Washington, D. C. Ocean Services Div.

NONSTEADY LABORATORY SIMULATION OF ATMOSPHERIC VORTICES: INERTIAL OSCILLATIONS AND TORNADO SKIP Interim Report

Jack A. C. Kaiser Oct. 1976 18 p refs (RR0310341)

(AD-A032680; NRL-8046) Avail: NTIS HC A02/MF A01 CSCL 04/1

Vortices generated in a rotating tank of water exhibited persistent oscillations which had periods close to the inertial period. The persistency of these oscillations suggested that tornado skip phenomena and the life cycle of concentrated atmospheric vortices might be closely linked with inertial oscillations of a tall vortex. This mechanism would provide a means to concentrate angular momentum near ground level to a larger extent than would steady inflow. Calculations of inertial periods for dust devils, water spouts, and tornadoes do agree with the skip interval for multiply occurring tornadoes or the life of concentrated atmospheric vortices. Author (GRA)

N77-22758# Ballistic Research Labs., Aberdeen Proving Ground, Md.

SYNOPSIS OF IONIZATION SOURCES IN THE MESOSPHERE AND STRATOSPHERE, WITH PARTICULAR EMPHASIS GIVEN TO THE PATH OF THE 26 FEBRUARY 1979 SOLAR ECLIPSE Final Report

Melvin G. Heaps Oct. 1976 46 p refs

(DA Proj. 1T1-62111-AH-71)

(AD-A032698; BRL-1938) Avail: NTIS HC A03/MF A01 CSCL 04/1

The sources of ionization in the mesosphere and stratosphere may be placed in three categories: solar radiation (photons), galactic cosmic rays, and precipitating energetic particles of solar and terrestrial origin and modulation. The ion-pair production rate Q (ion pairs per cubic centimeter per second) due to X-rays and EUV radiation is a function of latitude, time of day, solar declination, and the solar sunspot cycle. Solar radiation dominates the Q term in the upper mesosphere during the day. Galactic cosmic rays are the major source of ion pairs at night throughout the stratosphere and lower mesosphere and even into the upper mesosphere during geomagnetically quiet conditions. The Q term

due to galactic cosmic rays also displays a dependence on latitude and the solar cycle. Energetic particles (electrons = 40 keV, protons = 1 MeV, alpha particles = 5 MeV) can be the dominant source of ion pairs for short times in the stratosphere and mesosphere, competing with even solar radiation under some circumstances. The effects are more prominent at higher latitudes, particularly for protons. GRA

N77-22759# Aerospace Corp., El Segundo, Calif.
A CONTROLLED VLF PHASE-REVERSAL EXPERIMENT IN THE MAGNETOSPHERE Interim Report
H. C. Koons, M. H. Dazey, R. L. Dowden, and L. E. S. Amon 4 Nov. 1976 31 p refs Prepared in cooperation with Otago Univ.
(Contract F04701-76-C-0077; Grant NSF GA-37730)
(AD-A032993; TR-0077(2960-02)-1; SAMSO-TR-76-218) Avail: NTIS HC A03/MF A01 CSCL 04/1

During the 1973 operations of the transportable very-low-frequency (TVLF) transmitter near Anchorage, Alaska (L approx. 4), an experiment was performed to determine the effect of controlled phase changes of the transmitted wave on the magnetospherically propagated signal received in the conjugate region. At periodic intervals, the phase of the driving voltage was changed (essentially instantaneously) by 180 deg. The amplitude of the 6.6 kHz signal detected in the conjugate region went to zero and recovered with a characteristic time constant of 33 msec. This is ten times longer than the antenna current response time and is in fact comparable with characteristic electron interaction times with whistler-mode waves. Between the times at which the phase reversals occurred, the received signal was amplitude modulated. The period of the modulation was about 26 msec. An upper sideband was present in the spectrum while these pulsations were occurring. These characteristic times are in general agreement with theoretical predictions of bandwidths, growth rates, and particle trapping frequencies for whistler instabilities in the magnetosphere. Data obtained from the controlled transmissions and from lightning generated whistlers propagating in the same duct were combined to determine the plasma and wave parameters at the geomagnetic equator. Of particular interest is the level at which the magnetic field of the wave saturated. During the time period for which the data were analyzed, this was found to be 3.5 pT.
Author (GRA)

N77-22760*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
THE ANGULAR DISTRIBUTION OF AURORAL KILOMETRIC RADIATION Progress Report
J. L. Green, D. A. Gurnett, and S. D. Shawhan Aug. 1976 59 p refs Submitted for publication Sponsored in part by NSF
(Contracts NAS1-11257; NAS1-13129; NAS5-11074; NAS5-11431; Grants NGL-16-001-002; NGL-16-001-043; Contract N00014-76-C-0018)
(NASA-CR-152684; AD-A033218; U-of-Iowa-76-28) Avail: NTIS HC A04/MF A01 CSCL 04/1

Measurements of the angular distribution of auroral kilometric radiation (AKR) are presented using observations from the Hawkeye 1, IMP 6, and IMP 8 satellites. The wave experiments on Hawkeye 1 and IMP 6 provide electric field measurements of AKR in narrow frequency bands centered at 178, 100, and 56.2 kHz, and IMP 8 provides measurements at 500 kHz. From a frequency of occurrence survey, at satellite radial distances greater than 7 Re (earth radii), it is shown that AKR is preferentially and instantaneously being beamed into solid angles of approximately 3.5 steradians at 178 kHz, 1.8 steradians at 100 kHz, and 1.1 steradians at 56.2 kHz, directed upward from the night time auroral zones. Simultaneous multiple satellite observations of AKR in the Northern Hemisphere show that the radiation occurs simultaneously throughout these solid angles and that the topside plasmapause acts as an abrupt propagation cutoff on the nigh side of the earth. On the day side of the earth this abrupt cutoff at the plasmapause is not observed. The results of a computer ray tracing model qualitatively describing the propagation characteristics of AKR are also discussed. GRA

N77-22761# Nevada Univ., Reno. Lab. of Atmospheric Physics.
MEASUREMENT OF SIZE, CONCENTRATION AND STRUCTURE OF ATMOSPHERIC PARTICULATES BY THE AIRBORNE CONTINUOUS PARTICLE REPLICATOR Final Report, Apr. 1972 - Jul. 1976
John Hallett Jul. 1976 105 p refs
(Contract F19628-72-C-0280; AF Proj. 627A)
(AD-A033067; AFGL-TR-76-0149) Avail: NTIS HC A06/MF A01 CSCL 04/2

An assessment is made of the design characteristics of a continuous formvar cloud particle replicator for use on a pressurized aircraft such as the C130. Correction of measured replica particle concentrations is required depending on the siting of the instrument on the aircraft and the geometry of the collecting probe, to give free air concentration. A correction may also be required to the replica size to give the size of the particles prior to collection. Microscopy techniques for examination and photography of replica are described. Replica artifact results from coagulation, bounce, breakup, and direct condensation of vapor. A simple technique is described for estimate of particle mass from the replica dimensions. Author (GRA)

N77-22762# State Univ. of New York, Albany. Atmospheric Sciences Research Center.
ASSESSMENT OF ION-INDUCED STRATOSPHERIC AEROSOL FORMATION
Volker A. Mohnen and C. S. Kiang Apr. 1976 39 p refs
(Contract N00014-76-C-0283; Grant NSF DES-74-23-856)
(AD-A032549; ASRC-SUNY-Pub-402) Avail: NTIS HC A03/MF A01 CSCL 04/1

Based on current knowledge, an assessment of the role of ions in the stratospheric aerosol formation process is made. From our order-of-magnitude estimate it is shown that the impact of the average stratospheric ion population on aerosol formation processed in the unperturbed stratosphere is not significant.
Author (GRA)

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N77-22763*# Texas A&M Research Foundation, College Station. Dept. of Meteorology.
STUDY ON STEADY STATE WIND AND TURBULENCE ENVIRONMENTS Final Report
Kenneth C. Brundidge Feb. 1977 42 p refs
(Contract NAS8-31234)
(NASA-CR-150247) Avail: NTIS HC A03/MF A01 CSCL 04B

The structure of wakes and how this structure is related to the size and shape of buildings and other obstacles, and to ambient winds, was investigated. Mean values of natural atmospheric flow were obtained and used in conjunction with theoretical relationships developed by dimensional analysis to establish a model of the flow in the wake. Results indicate that conventional and V/STOL aircraft passing through the wake during takeoff and landing would experience not only a change in turbulence level, but also a change in mean wind speed of a magnitude roughly equivalent to that of the eddy components.
A.R.H.

N77-22764*# Science Applications, Inc., Huntsville, Ala.
ANALYSIS OF VECTOR WIND CHANGE WITH RESPECT TO TIME FOR CAPE KENNEDY, FLORIDA: WIND ALOFT PROFILE CHANGE VS. TIME, PHASE 1 Final Report, 15 Oct. 1976 - 14 Apr. 1977
Stanley I. Adelfang 14 Apr. 1977 752 p refs
(Contract NAS8-32226)
(NASA-CR-150238; SAI-78-552-HU) Avail: NTIS HC A99/MF A01 CSCL 04B

Wind vector change with respect to time at Cape Kennedy, Florida, is examined according to the theory of multivariate normality. The joint distribution of the four variables represented by the components of the wind vector at an initial time and after a specified elapsed time is hypothesized to be quadravariate

normal; the fourteen statistics of this distribution, calculated from fifteen years of twice daily Rawinsonde data are presented by monthly reference periods for each month from 0 to 27 km. The hypotheses that the wind component changes with respect to time is univariate normal, the joint distribution of wind component changes is bivariate normal, and the modulus of vector wind change is Rayleigh, has been tested by comparison with observed distributions. Statistics of the conditional bivariate normal distributions of vector wind at a future time given the vector wind at an initial time are derived. Wind changes over time periods from one to five hours, calculated from Jimsphere data, are presented. Author

N77-22765*# Virginia Univ., Charlottesville.
SIMULATION MODEL OF EROSION AND DEPOSITION ON A BARCHAN DUNE
Alan D. Howard, Jeffrey B. Morton, Mohamed Gal-el-Hak, and Deborah B. Pierce Washington NASA Apr. 1977 79 p refs
(Grant NGR-47-005-172)
(NASA-CR-2838) Avail: NTIS HC A05/MF A01 CSCL 04B

Erosion and deposition over a barchan dune near the Salton Sea, California, are modeled by bookkeeping the quantity of sand in saltation following streamlines of transport. Field observations of near surface wind velocity and direction plus supplemental measurements of the velocity distribution over a scale model of the dune are combined as input to Bagnold type sand transport formulas corrected for slope effects. A unidirectional wind is assumed. The resulting patterns of erosion and deposition compare closely with those observed in the field and those predicted by the assumption of equilibrium (downwind translation of the dune without change in size or geometry). Discrepancies between the simulated results and the observed or predicted erosional patterns appear to be largely due to natural fluctuations in the wind direction. The shape of barchan dunes is a function of grain size, velocity, degree of saturation of the oncoming flow, and the variability in the direction of the oncoming wind. The size of the barchans may be controlled by natural atmospheric scales, by the age of the dunes, or by the upwind roughness. The upwind roughness can be controlled by fixed elements or by sand in the saltation. In the latter case, dune scale is determined by grain size and wind velocity. Author

N77-22766# Saint Louis Univ., Mo. Dept. of Earth and Atmospheric Sciences.
RESEARCH TO DEVELOP IMPROVED MODELS OF CLIMATOLOGY THAT WILL ASSIST THE METEOROLOGIST IN THE TIMELY OPERATION OF THE AIR FORCE WEATHER DETACHMENTS, ADDENDUM
Donald E. Martin 31 Aug. 1976 108 p refs
(Contract F19628-74-C-0004)
(AD-A032317; AFGL-TR-76-0248-Add) Avail: NTIS HC A06/MF A01 CSCL 04/2

A documentation of the computer programs which commence with processing the hourly history tapes for any given station and end up with climatic forecast aids is presented. The procedure is as follows: (1) the hourly history tapes for any given station are stratified by wind direction; (2) the hourly observations in each of these respective wind-stratified subsets are further partitioned according to the latest observed temperature dew-point spread, (3) Type I and Type II unconditionals are produced for each subset of 2 above, (4) the products of step 3 are computer smoothed, (5) Type I smoothed unconditionals are entered on the ordinate and type II on the abscissa of a Stochastic model to produce conditional probability estimates, (6) these conditional probabilities are assessed to determine the height/distance at which the cumulated conditional probabilities attain a value of 50%, and (7) the data of steps 5 and 6 are formatted. GRA

N77-22767# Saint Louis Univ., Mo. Dept. of Earth and Atmospheric Sciences.
RESEARCH TO DEVELOP IMPROVED MODELS OF CLIMATOLOGY THAT WILL ASSIST THE METEOROLOGIST IN THE TIMELY OPERATION OF THE AIR FORCE WEATHER DETACHMENTS Final Report, 1 Jul. 1975 - 31 Aug. 1976
Donald E. Martin 31 Aug. 1976 58 p refs
(Contract F19628-74-C-0004)
(AD-A032318; AFGL-TR-76-0249-Add) Avail: NTIS HC A04/MF A01 CSCL 04/2

This research provides a means of modelling the joint relationships of ceiling and visibility probabilities among stations as a function of distance and season. Analytic formulations are presented which show definite skill over the assumption of data independency. These functions carry the added advantage of being applicable for any route irrespective of direction, topography or location. A preliminary attempt has also been made to compact the unconditional probabilities at any station for limited elements into forms amenable for rapid computer storage and retrieval. Discussions of the results, verifications and approaches to the above topics are presented. Author (GRA)

N77-22768# MB Associates, San Ramon, Calif.
WEATHER MODIFICATION DESIGN STUDY FOR STREAMFLOW AUGMENTATION IN THE NORTHERN SIERRA NEVADA. VOLUME 1: METEOROLOGY AND HYDROLOGY OF THE NORTHERN SIERRA NEVADA Final Report, May 1975 - Jul. 1976
C. C. Lovell, A. K. Goroch, and K. W. Chu Jul. 1976 169 p refs
(Contract DI-14-06-D-7659)
(PB-262034/2; MB-R-76/75A-Vol-1) Avail: NTIS HC A08/MF A01; also available in set of 4 reports HC E09, PB-262033-SET CSCL 04B

The results of a design study for a pilot program to augment snowpack in the Sierra Nevada are presented. The background for the program includes a review of the synoptic and mesoscale climatology and the cloud physics of winter storms in the area. The climatology and cloud physics relationships to precipitation occurrence, rate, and duration within the river basins under consideration are established. A hydrology model was used to estimate the runoff enhancement potential as a function of the type of precipitation and target areas. The result of these simulations is followed by a review of the state of cloud model development and of possible uses of models in a pilot program. GRA

N77-22769# MB Associates, San Ramon, Calif.
WEATHER MODIFICATION DESIGN STUDY FOR STREAMFLOW AUGMENTATION IN THE NORTHERN SIERRA NEVADA. VOLUME 2: PHYSICAL AND STATISTICAL DESIGN Final Report, May 1975 - Jul. 1976
C. C. Lovell, A. K. Goroch, and K. W. Chu Jul. 1976 81 p refs Prepared in cooperation with Meteorology Research, Inc.
(Contract DI-14-06-D-7659)
(PB-262035/9; MB-R-76/75A-Vol-2) Avail: NTIS HC A05/MF A01; also available in set of 4 reports, HC E09, PB-262033-SET CSCL 04B

The results of a design study for a pilot program to augment snowpack in the Sierra Nevada are presented. The background for the program includes a review of the synoptic and mesoscale climatology and the cloud physics of winter storms in the area. The climatology and cloud physics relationships to precipitation occurrence, rate, and duration within the river basins under consideration are established. A hydrology model was used to estimate the runoff enhancement potential as a function of the type of precipitation and target areas. This background information is synthesized to form a physical model of precipitation mechanisms in the Sierra Nevada. GRA

N77-22770# MB Associates, San Ramon, Calif.
WEATHER MODIFICATION DESIGN STUDY FOR STREAMFLOW AUGMENTATION IN THE NORTHERN SIERRA NEVADA. VOLUME 3: OPERATIONAL DESIGN Final Report, May 1975 - Jul. 1976
C. C. Lovell, A. K. Goroch, and K. W. Chu Jul. 1976 91 p refs
(Contract DI-14-06-D-7659)
(PB-262036/7) Avail: NTIS HC A05/MF A01; also available in set of 4 reports, HC E09, PB-262033-SET CSCL 04B

The results of a design study for a pilot program to augment snowpack in the Sierra Nevada are presented. The background for the program includes a review of the synoptic and mesoscale climatology and the cloud physics of winter storms in the area. The climatology and cloud physics relationships to precipitation occurrence, rate, and duration within the river basins under

consideration are established. The operational requirements are also presented. GRA

N77-22771# MB Associates, San Ramon, Calif.
WEATHER MODIFICATION DESIGN STUDY FOR STREAMFLOW AUGMENTATION IN THE NORTHERN SIERRA NEVADA. EXECUTIVE SUMMARY Final Report, May 1975 - Jul. 1976
C. C. Lovell, A. K. Goroch, and K. W. Chu Jul. 1976 44 p refs
(Contract DI-14-06-D-7659)
(PB-262037/5; MB-R-76/75A) Avail: NTIS HC A03/MF A01; also available in set of 4 reports HC E09, PB-262033-SET CSCL 04B

The results of a design study of a pilot program to augment snowpack in the Sierra Nevada are presented. The climatology and cloud physics relationships to precipitation occurrence, rate, and duration within the river basins under consideration is established. A hydrology model was used to estimate the run-off enhancement potential as a function of the type of precipitation and target areas. The result of these simulations is followed by a review of the state of cloud model development and of possible uses of models in a pilot program. Finally, the seeding potential of Sierra Nevada storms is explored. GRA

N77-22772# National Oceanic and Atmospheric Administration, Asheville, N. C.
HIGH ALTITUDE METEOROLOGICAL DATA, VOLUME 12, NO. 4. QUARTERLY ISSUE OCTOBER-NOVEMBER-DECEMBER 1975
1976 576 p
(PB-261988/0; NOAA-76111018) Avail: NTIS MF A01; HC Avail: National Climatic Center, Federal Bldg., Asheville, N. C. 28801. Attn: Publications CSCL 04B

Each metrocket report includes measured wind and/or temperature and computed values of pressure, density, speed of sound, and fall velocity for significant levels, constant pressure levels, and interpolated 1 kilometer intervals. Also included is a corawinsonde report used primarily to provide a base level for computing the metrocket thermodynamic data. GRA

N77-22773# National Oceanic and Atmospheric Administration, Asheville, N. C.
HIGH ALTITUDE METEOROLOGICAL DATA, VOLUME 12, NO. 2. QUARTERLY ISSUE APRIL-MAY-JUNE 1975
1976 520 p
(PB-261987/2; NOAA-76111017) Avail: NTIS MF A01; HC Avail National Climatic Center, Federal Bldg., Asheville, N.C. 28801. Attn: Publications CSCL 04B
For abstract, see N77-22772.

N77-22774# National Oceanic and Atmospheric Administration, Boulder, Colo. Weather Modification Program Office.
AN ALGORITHM BASED ON INTRINSIC ANALYSIS FOR INVESTIGATING DIGITIZED RADAR DATA FROM HURRICANES
Richard W. Knight (Natl. Hurricane and Experimental Meteorol. Lab., Coral Gables, Fla.) and Bernard E. Howard (Natl. Hurricane and Experimental Meteorol. Lab., Coral Gables, Fla.) Oct. 1976 30 p refs
(PB-262464/1; NOAA-TM-ERL-WMPO-34; NOAA-76111701) Avail: NTIS HC A03/MF A01 CSCL 04B

It is hypothesized that gravity waves generated in a hurricane may be responsible for triggering some of the convection in the hurricane environment. If the hypothesis is true, it is expected that periodic pulses in the observed intensity of convection will be found in certain regions of the storm that are affected by these waves. The algorithm that is described is a procedure for processing high resolution digitized radar data from hurricanes to investigate the question of whether significant periodicities in convection intensity do exist. The algorithm is based on intrinsic analysis, a data reduction technique that allows signal data to be approximated by basis functions that are extracted from the signal ensemble. The intrinsic basis has two highly desirable qualities, viz: it allows signal data to be approximated by a minimum number of coefficients, and the intrinsic wave forms can be physically interpreted. Heuristic descriptions of the technique and the algorithm are given. Finally, a hypothetical data sample is processed and a step-by-step demonstration of the procedure is presented. GRA

N77-22775# Northwestern Univ., Evanston, Ill. Dept. of Civil Engineering.
STOCHASTIC MODELLING OF SITE WIND CHARACTERISTICS Final Report, Jan. 1975 - Sep. 1976
Ross B. Corotis Nov. 1976 311 p refs Sponsored in part by ERDA
(PB-261178/8; ERDA/NSF-00357/76/1) Avail: NTIS HC A14/MF A01 CSCL 04B

Statistical methods and probability models are used to determine optimal evaluation procedures for survey data. Several years of hourly records from six Midwest sites and one Rocky Mountain site provide a data base to develop the models and procedures. GRA

N77-22776# National Bureau of Standards, Washington, D. C. Center for Building Technology.
PROBABILITY DISTRIBUTIONS OF EXTREME WIND SPEEDS Final Report
Emil Simiu and James J. Filliben 1976 19 p refs Repr. from J. Struct. Div. Proc. Am. Soc. Civil Eng., v. 102, no. ST9, Sep. 1976 p 1861-1877
(PB-260898/2) Avail: NTIS HC A02/MF A01 CSCL 04B

With a view to assessing the validity of current probabilistic approaches to the definition of design wind speeds, a study was undertaken of extreme wind speeds based on records taken at 20 U.S. weather stations. The assumption that a single probability distribution is universally applicable to all extreme wind data sets in a given type of climate was not confirmed. Predictions of 100-year wind speeds based on overlapping 20-year sets of data taken at the same station differed between themselves by as much as 65%. Similar predictions for 1000-year winds differed by as much as 150%. Since wind pressures are proportional to the square of the wind speeds, errors of such magnitude are unacceptably high for structural design purposes. It is therefore suggested that extreme caution should be exercised in establishing and using probabilistically defined design wind speeds. GRA

N77-22777# Chicago Univ., Ill. Cloud Physics Lab.
PROJECT METROMEX Annual Report, 1 May 1975 - 30 Apr. 1976
Roscoe R. Braham, Jr. 1 Jul. 1976 31 p
(Grant NSF AEN-72-03399-A03)
(PB-261071/5; UCHI-CPL-76-48) Avail: NTIS HC A03/MF A01 CSCL 04B

Observations and measurements in the St. Louis, Mo. area and from Champaign, Ill. are reported. Plume maps of Aitken particles are given and the association with SO2 discussed. Radar measurements document an effect of St. Louis upon rain initiation and the development of thunderstorms. Data on giant aerosol particles are given. GRA

N77-22778# Colorado Univ., Boulder. Inst. of Behavioral Science.
DROUGHT HAZARD IN THE UNITED STATES: A RESEARCH ASSESSMENT
Richard A. Warrick, Patricia B. Trainer, Earl J. Baker, and Waltraud A. R. Brinkmann 1975 217 p refs
(Grant NSF G132942)
(PB-262022/7; NSF/RA/E-75/004; LC-75-620046) Avail: NTIS HC A10/MF A01 CSCL 04B

Specific topics discussed are: description of the hazard (nature of the physical event, agricultural drought regions of the United States); the social consequences (determining the consequences, effects of drought in a general systems framework, physical drought impact and evolving agricultural patterns in the great plains, the social consequences of drought in the great plains--an historical perspective); the social response (adjustments to natural event subsystem, adjustment to agricultural subsystem, combination of adjustments, interaction of adjustments); since the 1930's (adjustment trends, attainment of social aims, influence of exogenous factors and the future outlook, summary and conclusions); the problem of urban drought (the concept of effective drought, urban drought in a systems context, the physical effects and social impacts, adjustments to urban drought,

adjustments--attainment of social aims, future forces affecting water demand and quality); agricultural drought research. GRA

N77-22779# National Weather Service, Silver Spring, Md. Techniques Development Lab.
VERIFICATION OF SEVERE LOCAL STORM WARNINGS BASED ON RADAR ECHO CHARACTERISTICS
Jun. 1976 31 p refs
(PB-262417/9; NOAA-TM-NWS-TDL-60; NOAA-76112406) Avail: NTIS HC A03/MF A01 CSCL 04B

An attempt was made to verify severe local storm warnings with information contained in manually digitized radar reports and severe local storm climatology data. Results of the verification indicate that in the spring months there is some skill demonstrated in these warnings especially in areas close to radar sites. This skill decreases noticeably in the summer months and in areas more remote from radar sites. GRA

N77-22780# National Oceanic and Atmospheric Administration, Boulder, Colo. Wave Propagation Lab.
FEASIBILITY OF ATMOSPHERIC TEMPERATURE SENSING FROM OCEAN DATA BUOYS BY MICROWAVE RADIOMETRY
E. R. Westwater, M. T. Decker, and F. O. Guiraud Jul. 1976 38 p refs
(PB-262421/1; NOAA-TR-ERL-375; NOAA-76112403) Avail: NTIS HC A03/MF A01 CSCL 04B

The feasibility of measuring atmospheric temperature structure by using a microwave radiometer mounted on an ocean-based data buoy was investigated with simulated measurements. The accuracy of layer-averaged temperature retrievals was studied as a function of radiometer noise level, various choices of frequency, number of channels, layer pressure thickness, clear vs. cloudy skies, and five ocean climatologies. GRA

N77-22781# Colorado Univ., Boulder. Inst. of Behavioral Science.
SEVERE LOCAL STORM HAZARD IN THE UNITED STATES: A RESEARCH ASSESSMENT
Waltraud A. R. Brinkmann (Wisconsin Univ., Madison) 1975 171 p refs
(PB-262025/0; NSF/RA/E-75-011) Avail: NTIS HC A08/MF A01 CSCL 04B

Specific topics discussed are the following: Tornado--Meteorological description of tornadoes, Dimensions of the tornado hazard in the United States, Adjustments of the tornado hazard, Research opportunities; Hail--Physical aspects of the hail hazard, Damage potential and losses from hail, Adjustments to the hail hazard, Research opportunities; Lightning--Nature of the hazard, Dimensions of the lightning hazard, Adjustments to the lightning hazard, Research opportunities. GRA

N77-22782# Aerometric Research, Inc., Goleta, Calif.
COLORADO RIVER BASIN PILOT PROJECT COMPREHENSIVE EVALUATION REPORT: FIVE WINTER SEASONS, 1970-71 TO 1974-75 Final Report, 1970-1975
Robert D. Elliot, Russell W. Shaffer, Arnold Court (California State Univ., Northridge), and Jack F. Hannaford (Sierra Hydrotech. Placerville, Calif.) Oct. 1976 650 p refs
(Contract DI-14-06-D-7332)
(PB-262057/3; ARI-76-1) Avail: NTIS HC A99/MF A01 CSCL 04B

Nucleant dispersion based on wind flow, an analysis of precipitation and rawinsonde data that is essentially diagnostic in character, and an analysis of surface run off related to precipitation was investigated. Analyses of precipitation and other records for all five years of the pilot project operation are also included. Conclusions and recommendations are presented which can serve as guidance material for planning orographic research projects. GRA

N77-22783# Florida State Univ., Tallahassee. Dept. of Meteorology.
COASTAL UPWELLING ECOSYSTEMS ANALYSIS. A CASE STUDY OF A LAND-SEA BREEZE PHENOMENON OVER THE WESTERN AFRICAN COAST
Michael S. Uhart Jul. 1976 138 p refs
(Grant NSF OCE-75-6469-A02)
(PB-261869/2; FSU-CUEA-MET-76-1; NSF/IDOE-76-189; TR-28) Avail: NTIS HC A07/MF A01 CSCL 04B

Meteorological observations were taken at buoy and land surface stations and by a research aircraft from March 13 through March 20, 1974 on the western African Coast. The purpose was to document the spatial and temporal variations of the land-sea breeze circulation and to investigate any relationship it may have to the marine inversions. A description of field observations is given. Time profiles of surface data and morning and afternoon vertical cross-sections of potential temperature, relative humidity, temperature, and the u-component of the wind are displayed. These mesoscale features are discussed and related to the surface and upper level synoptic scale features. GRA

N77-22784# Fraunhofer-Gesellschaft, Garmisch-Partenkirchen (West Germany).
BOUNDARY LAYER AEROSOL TRANSPORT MEASUREMENTS IN A VALLEY SYSTEM, PART 3 Final Technical Report, Sep. 1975 - Jun. 1976
Reinhold Reiter and Rudolf Sladkovic Jul. 1976 111 p refs
(Grant DA-ERO-75-G-042)
(AD-A031804) Avail: NTIS HC A06/MF A01 CSCL 04/1

The transport of aerosols in a mountain valley has been investigated by means of field experiments. This report is based on eight such experiments, which have been conducted under various meteorological conditions (stability classes B, C, and D after Pasquill, Turner, Etc). A complete set of measured data like particle distributions, wind profiles, balloon trajectories, and temperature probings will be presented. The particle propagation of the single experiment will be compared with the theoretical distribution and influences of valley shape and temperature inversion on the actual distribution will be discussed. Author (GRA)

N77-22785# Digital Programming Services, Inc., Waltham, Mass.
CONTINUATION OF DEVELOPMENT AND APPLICATION OF DATA PROCESSING TECHNIQUES AND ANALYTIC PROCEDURES TO CLOUD PHYSICS DATA Final Report, 1 Jul. 1975 - 30 Jun. 1976
Lawrence E. Belsky, Michael W. Francis, Fredric B. Kaplan, and John E. ONeil 30 Jul. 1976 201 p refs
(Contract F19628-76-C-0051)
(AD-A033234; AFGL-TR-76-0182) Avail: NTIS HC A10/MF A01 CSCL 04/1

This report outlines the data collection procedures utilized in processing cloud physics data. The real time operating system on board the C130E aircraft is fully explained. Practical applications of various mathematical techniques (such as: Newton's forward formula, least square curve fitting, Pappus-Guldinus Theorem etc.) are fully delineated. Author (GRA)

N77-22786# Florida State Univ., Tallahassee. Dept. of Statistics.
BIBLIOGRAPHY OF STATISTICAL AND METEOROLOGICAL METHODOLOGY IN WEATHER MODIFICATION
Morgan A. Hanson, Charles L. Bach, Edward A. Cooley, and Ralph A. Bradley Sep. 1976 149 p refs
(Contract N00014-76-C-0394)
(AD-A032729; FSU-Statistics-M388; ONR-TR-110) Avail: NTIS HC A07/MF A01 CSCL 04/2

This collection of abstracts has been compiled within the Departments of Statistics and Meteorology at Florida State University for use in research in weather modification. Motivation for the bibliography arose in association with an ONR sponsored research contract in the design and analysis of weather modification experimentation under the direction of Ralph A. Bradley as Principal Investigator. It is envisaged that it will be of wide general use. The compilation has involved a systematic search of all available relevant meteorological and statistical journals, reports of symposia, and cross checks of references in the sources. GRA

N77-22787# Meteorology Research, Inc., Altadena, Calif.
PMS PRECIPITATION PROBE INTER-COMPARISONS AND CORRELATIONS WITH RADAR MEASUREMENTS Final Report
E. Lobl, A. J. Heymsfield, R. E. Carbone, and L. J. Jahnsen

27 Feb. 1976 60 p refs
(Contract DNA001-75-C-0040)
(AD-A033280; MRI-76-FR-1400; DNA-3992F) Avail: NTIS HC A04/MF A01 CSCL 04/2

Two versions of PMS precipitation probes are compared from simulataneous spectrum measurements. Systematic probe differences reveal undersizing and depth-of-field problems with the 'wide-arm' (4,500 micrometers) probe. Radar comparisons with the aircraft data substantiate the deduced problems, and quantitative correction procedures are developed and demonstrated for the 'wide-arm' probe. Instances of very large radar discrepancies are shown to be caused in part by poor selection of particle phase and/or habit. Author (GRA)

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N77-22788# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
A COMPARISON OF SATELLITE-OBSERVED SEA-SURFACE TEMPERATURES WITH GROUND TRUTH IN THE INDIAN OCEAN
Ants Leetmaa and Matthew Cestari Aug. 1976 17 p refs
(PB-262414/6; NOAA-TR-ERL-376; AOML-22; NOAA-76112404) Avail: NTIS HC A02/MF A01 CSCL 08J

Daily worldwide sea-surface temperature maps are produced by the National Environmental Satellite Service. For the first half of 1975, sea-surface temperatures recorded on these maps were compared with concurrent ship observations in the Indian Ocean. Additional comparisons were made with historical data. These show systematic differences between the satellite and sea-surface observations. The satellite-derived temperatures appear to be too low along the equator and along the East African coast in the vicinity of the equator. GRA

N77-22789# National Weather Service, Silver Spring, Md. Techniques Development Lab.
A SHEARED COORDINATE SYSTEM FOR STORM SURGE EQUATIONS OF MOTION WITH A MILDLY CURVED COAST
Chester P. Jelesnianski Jul. 1976 60 p refs
(PB-261956/7; NOAA-TM-NWS-TDL-61; NOAA-76102101) Avail: NTIS HC A04/MF A01 CSCL 08C

To improve numerical computations of coastal storm surges, a mildly curved coastline is shifted or sheared onto a straight baseline. A surface plane, truncated from the ocean shelf and containing the curved coast as a boundary, is fitted with a curved, non-orthogonal grid. The plane with curved boundaries is then transformed via a sheared coordinate system onto an image rectangle. In the transformed system, the computational grid is cartesian, orthorgonal, equally spaced, and the coast lies exactly on and not across a grid line. Linearized transport equations of motion for storm surges are modified to accommodate the sheared coordinate system. GRA

N77-22790# National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.
FORMULAS USED TO ANALYZE WIND-DRIVEN CURRENTS AS FIRST-ORDER AUTOREGRESSIVE PROCESSES
Harold O. Mofield and Dennis Mayer (NOAA, Miami, Fla.) Aug. 1976 25 p refs
(PB-262463/3; NOAA-TM-ERL-PMEL-7; NOAA-76111702) Avail: NTIS HC A02/MF A01 CSCL 08C

A set of numerical experiments with synthetic data shows that the formulas give accurate results with both white and nonwhite noise forcing and with either filtered or non-filtered data. The formulas are a significant improvement over those traditionally used in autoregression analysis based on covariances. GRA

N77-22791# Environmental Research Inst. of Michigan, Ann Arbor.
WAVE VELOCITY EFFECTS ON SAR IMAGERY AS OBSERVED IN THE OPTICAL PROCESSOR
R. A. Shuchman and J. S. Zelenka 20 Aug. 1976 17 p ref
(Grant NOAA-04-6-158-44078)
(PB-262439/3; ERIM-123000-5-T; NOAA-76112908) Avail: NTIS HC A02/MF A01 CSCL 08C

ERIM X-L data collected at Marineland on December 15, 1975 was selected for the experimental study. Using data that covered shallow, deep, and Gulf Stream conditions, wave velocity and direction was transferred into velocities that correspond to positive or negative motion parallel to the aircraft direction (i.e. traveling essentially in the azimuth direction). GRA

N77-22792# Environmental Research Inst. of Michigan, Ann Arbor.
PRELIMINARY ENGINEERING MEASUREMENTS FROM L-BAND DATA COLLECTED AT MARINELAND
J. S. Zelenka, R. Shuchman, and A. Klooster 27 Aug. 1976 21 p Revised
(PB-262500/2; ERIM-123000-6-T-Rev) Avail: NTIS HC A02/MF A01 CSCL 08C

Some preliminary measurements obtained from the L-Band, H-H polarization data collected with the ERIM multichannel radar are reported. A portion of the L-Band data collected near the Gulf Stream was scanned in the image plane of an optical processor. The resulting measurement enabled investigators to obtain an estimate of the modulation depth associated with this particular example of wave imagery, and the results should be representative of the prevailing seastate. GRA

N77-22793# Naval Intelligence Support Center, Washington, D. C.
METHOD AND SOME RESULTS OF ADAPTIVE MEASUREMENTS
A. G. Kolesnikov 27 Oct. 1976 13 p refs Transl. into ENGLISH from Morskoy Gidrofizicheskiy Institut (USSR), v. 56, no. 6, 1971 p 95-108
(AD-A033045; NISC-Trans-3871) Avail: NTIS HC A02/MF A01 CSCL 08/10

The article presents the principles of investigation of physical fields in the ocean with adaptation of the measuring algorithm to the statistical structure of a field and describes the results of experiments. GRA

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N77-22794* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
APPLICATION OF LUCIFERASE ASSAY FOR ATP TO ANTIMICROBIAL DRUG SUSCEPTIBILITY Patent
Emmett W. Chappelle, Grace L. Picciolo, Hillar Vellend (New England Medical Center, Boston), Stephanie A. Tuttle (New England Medical Center, Boston), Michael J. Barza (New England Medical Center, Boston), and Louis Weinstein, inventors (to NASA) (New England Medical Center, Boston) Issued 29 Mar. 1977 10 p Filed 30 Apr. 1975 Supersedes N75-26629 (13 - 17, p 2155)
(NASA-Case-GSC-12039-1; US-Patent-4,014,745; US-Patent-Appl-SN-572991; US-Patent-Class-195-103.5K; US-Patent-Class-195-103.5R) Avail: US Patent Office CSCL 06C

The susceptibility of bacteria, particularly those derived from body fluids, to antimicrobial agents is determined in terms of an ATP index measured by culturing a bacterium in a growth medium. The amount of ATP is assayed in a sample of the cultured bacterium by measuring the amount of luminescent light emitted when the bacterial ATP is reacted with a luciferase-luciferin mixture. The sample of the cultured bacterium is subjected to an antibiotic agent. The amount of bacterial adenosine triphosphate is assayed after treatment with the antibiotic by measuring the luminescent light resulting from the reaction. The ATP index is determined from the values obtained from the assay procedures. Official Gazette of the U.S. Patent Office

N77-22795*# Lockheed Electronics Co., Houston, Tex. Aerospace Systems Div.

THE ANOMALY DATA BASE OF SCREWWORM INFORMATION
L. E. Giddings Oct. 1976 688 p refs
(Contract NAS9-12200)
(NASA-CR-151333; LEC-7922) Avail: NTIS HC A99/MF A01 CSCL 06C

Standard statistical processing of anomaly data in the screwworm eradication data system is possible from data compiled on magnetic tapes with the Univac 1108 computer. The format and organization of the data in the data base, which is also available on dedicated disc storage, are described. Author

N77-22796# Arizona Univ., Tucson. Dept. of Chemistry.
FREE RADICALS IN BIOLOGICAL ENERGY CONVERSION: EPR STUDIES OF MODEL SYSTEMS Final Report
G. Tollin 31 Aug. 1976 20 p refs
(Contract E(11-1)-908)
(COO-908-50) Avail: NTIS HC A02/MF A01

The molecular-electronic mechanism of chlorophyll participation in photosynthesis was elucidated. The following reactions were observed: (1) Photoproduction of C(+) (chlorophyll cation radical) in solution in the absence of added electron acceptors. This is a low quantum yield reaction which proceeds via the lowest excited singlet state. Bacteriochlorophyll also undergoes this reaction, whereas pheophytin does not. (2) One-electron phototransfer between the chlorophyll lowest triplet state and quinones to yield a radical pair (C(+) - Q(+) (quinone radical). This may either recombine or separate. The C(+) formed upon separation is unstable and reacts with hydroxylic compounds to regenerate chlorophyll. The Q(-) species partly reacts with oxidized solvent and partly disproportionates. Both bacteriochlorophyll and pheophytin are also able to react with quinones in this manner. The quenching of the chlorophyll lowest singlet state by quinones does not, however, lead to detectable radical formation. These reactions seem to provide acceptable models for certain aspects of photosynthetic energy conversion, and thus elucidation of their detailed mechanisms should lead to useful insights into the nature of the biological process. ERA

N77-22797# Bureau of Radiological Health, Rockville, Md.
SYMPOSIUM ON BIOLOGICAL EFFECTS AND MEASUREMENT OF LIGHT SOURCES
DeWitt G. Hazzard Oct. 1976 252 p Conf held at Rockville, Md., 25-26 Mar., 1976 Sponsored by HEW
(PB-261167/1; FDA/BRH-77/11; DHEW/PUBL/FDA-77/8002) Avail: NTIS HC A12/MF A01 CSCL 06R

Presentations and subsequent discussions cover subject areas such as physiological and ocular responses to light, effects of light on biochemical and cellular response in bacterial and mammalian cell systems and measurement of coherent and noncoherent light sources. GRA

52 AEROSPACE MEDICINE

Includes physiological factors, biological effects of radiation; and weightlessness.

N77-22798# School of Aerospace Medicine, Brooks AFB, Tex.
THERMAL RESPONSES TO HIGH-FREQUENCY ELECTROMAGNETIC RADIATION FIELDS Interim Report, 1 Jul. - 1 Sep. 1975
James W. Frazier, James H. Merritt, Stewart J. Allen, Richard H. Hartzell, and James A. Ratliff Sep. 1976 20 p refs
(AD-A032179; SAM-TR-76-20) Avail: NTIS HC A02/MF A01 CSCL 06/18

Monkeys were exposed to fields of 1000, 750, and 500 mW/sq cm. at 26 MHz in a coaxial transmission line for 6 hours. An immediate rise in skin and rectal temperature, with subsequent cooling, was noted. Rectal temperature reached an equilibrium after about 1.5 hours of exposure. This equilibrium was maintained throughout the remainder of the explosure period. Thermoregulatory mechanisms activated as a result of exposure to even the highest power (1000 mW/sq cm.) appear adequate to dissipate the imposed heat load. Author (GRA)

N77-22799# Indianapolis Center for Advanced Research, Ind.
THERAPEUTIC AND DIAGNOSTIC CAPABILITIES OF ULTRASOUND IN ISCHEMIC AND INFARCTED MYOCARDIUM Annual Report, 30 Jun. 1975 - 15 Apr. 1976
Thomas D. Franklin, Jr. Apr. 1976 20 p
(Contract HV-4-3004)
(PB-262085/4; NIH-N01-HV-53004-A76) Avail: NTIS HC A02/MF A01 CSCL 06E

The effect of low intensity ultrasonic therapy on infarcted myocardium in the dog was evaluated. Degrees of collagen formation, vascularity, and perivascular sparing in the infarcted region were analyzed. Forty dogs were acutely infarcted via coronary artery ligation and treated for a six week period with either ultrasonic therapy or placebo massage. Gross infarct mapping using enzyme specific staining techniques was carried out. Histological verification of the infarctions was made and a pathological evaluation completed. A decrease in the dense collagen content of the infarcted areas treated with ultrasound was a qualitative finding, and a larger number of viable myocardial islands was also noted. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N77-22800# Washington Univ., Seattle. Dept. of Psychology.
CHANGES IN BEHAVIOR FOLLOWING CHANGES IN CONTROL OVER OUTCOMES: A THEORY BASED ON RESPONSES TO UNCERTAINTY
James R. Larson, Jr. and Terence R. Mitchell Sep. 1976 116 p refs
(Contract N00014-76-C-0193)
(AD-A033562; TR-76-3) Avail: NTIS HC A06/MF A01 CSCL 05/10

A theory to predict outcome-oriented effort following changes in control over outcomes is proposed. This theory is based on a hypothesized motivation to avoid uncertainty. As uncertainty about control increases, individuals should become increasingly motivated to seek uncertainty-reducing information. They should thus become increasingly motivated to exert outcome-oriented effort in an attempt to provide more information about the consequences of their behavior. Changes are seen as a function of one's uncertainty about control both before and after the change in control. The relationship between this theory and several other psychological theories is discussed. Author (GRA)

N77-22801# Decisions and Designs, Inc., McLean, Va.
ASSESSMENT OF GROUP PREFERENCES AND GROUP UNCERTAINTY FOR DECISION MAKING Technical Report, Jul. 1975 - Sep. 1976
David A. Seaver Jun. 1976 68 p refs Prepared by Univ. of Southern Calif., Los Angeles
(Contract N00014-76-C-0074; ARPA Order 3052)
(AD-A033246; SSRI-76-4) Avail: NTIS HC A04/MF A01 CSCL 05/10

Often groups rather than individuals function as decision makers. To use decision analysis to aid such decision makers, group preferences and opinions must be quantified as utilities and probabilities. This paper reviews the procedures by which these group utilities and probabilities can be determined, along with the relative merits of individual versus group judgments of these quantities. While group judgments are generally superior to individual judgments, no entirely satisfactory method for determining either group utilities or probabilities exists. Using ordinal preferences rather than cardinal utilities, majority rule will lead to a satisfactory group preference function in certain restricted situations. Both mathematical aggregation rules and behavioral approaches have been suggested for obtaining group probabilities. The mathematical approaches range from the simple to complex. The theoretically elegant methods, however, generally suffer in practice from the impossibility of determining some of the inputs necessary for the models. The behavioral approaches attempt to reduce disagreement by communication and interaction

among the group members. The most successful methods depend on structural communication to allow the facilitation of group judgments while avoiding many of the detrimental influences that have been identified in social psychological research. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N77-22802# Calspan Corp., Buffalo, N.Y.
AUTOMOBILE CONSUMER INFORMATION CRASH TEST PROGRAM, VOLUME 2 Final Technical Report, Jun. 1974 - Jan. 1976
N. E. Shoemaker, M. O. Ryder, and N. J. Deleys Nov. 1976 270 p refs
(Contract DOT-HS-4-00910)
(PB-262411/2; CALSPAN-ZT-5561-V-29-Vol-2; DOT-HS-802011-A) Avail: NTIS HC A12/MF A01 CSCL 13F

The full-scale crash testing program included frontal barrier and car to car front-to-side and front-to-rear impacts in 22 test vehicles. The vehicle structure and occupant computer models are briefly described, and comparisons of simulated and actual crash test results are presented. The methodology and results of static crush tests that were performed to obtain data on the force-deflection properties of the major vehicle structural components for input to the vehicle response models are also presented. GRA

N77-22803# Transportation Research Board, Washington, D.C.
DESIGN FOR CRASH SURVIVAL OF AUTOMOBILE OCCUPANTS
1976 66 p refs Presented at the 54th Ann. Meeting of the Transportation Res. Board.
(PB-261194/5; TRB/TRR-586; ISBN-0-309-02550-8) Avail: NTIS HC A04/MF A01 CSCL 13L

The crash environment, human injury mechanisms and impact tolerance, and subcompact car crashworthiness were studied. Impact performance and an evaluation criterion for median barriers, and automobile-attenuator compatibility in 1985-some designer guidelines were the other topics considered. GRA

N77-22804# Virginia Univ., Charlottesville. Dept. of Chemical Engineering.
ENZYME APPLICATIONS IN THE VAPOR PHASE AND ON ELECTRICALLY CONDUCTING SURFACES Final Report
Donald J. Kirwan Oct. 1976 30 p refs
(Grant NSF APR-72-03442-A04)
(PB-261710/8; UVA/526119/CHE76/101; NSF/RA-760312) Avail: NTIS HC A03/MF A01 CSCL 06I

This program is concerned with two applied projects: an electrochemical method of water disinfection and air disinfection using a filter with immobilized hydrolytic enzymes. The general objectives include: (1) research and development of an electrochemical device for destruction of water-borne pathogens such as bacteria and virus; (2) an investigation of immobilized enzymes for disinfection of air and water; (3) characterizations of immobilized enzymes operating in an aerosol or a continuous liquid phase environment; (4) a study of the use of electrosorption as a biological separation process; (5) research on immobilized whole cell reactors for nitrogen fixation; and (6) an investigation of the interactions of whole cells and electrodes to develop a new method for detection of viable organisms, viruses, and antibiotics. GRA

N77-22805# Army Aeromedical Research Lab., Fort Rucker, Ala.
IN-FLIGHT PERFORMANCE WITH NIGHT VISION GOGGLES DURING REDUCED ILLUMINATION Final Report
Michael A. Lees, David D. Glick, Kent A. Kimball, and Allen C. Snow, Jr. Aug. 1976 39 p refs
(AD-A031991; USAARL-76-27) Avail: NTIS HC A03/MF A01 CSCL 17/8

At the present time the U.S. Army is striving to attain around-the-clock operational capability for its tactical forces. The Night Vision Goggles have been developed to aid the Army pilot in attaining near-daytime capability at night. Previous research at the U.S. Army Aeromedical Research Laboratory has demonstrated the requirement for an investigation of the effects of low illuminance levels on aviator performance while wearing night vision goggles. Author (GRA)

N77-22806# Navy Clothing and Textile Research Unit, Natick, Mass.
PHYSIOLOGICAL TESTING OF WHITE PHOSPHOROUS PROTECTIVE CLOTHING
Dale A. Reins and James C. Shampine Oct. 1976 30 p refs (AD-A033027; TR-116) Avail: NTIS HC A03/MF A01 CSCL 06/17

The physical stresses imposed on personnel wearing the white phosphorous protective clothing (WPPC) in hot climates were ascertained. Clothing was worn in ambient temperatures of 100 and 120F during light and moderately heavy work periods. Clothing was worn with the flaps open and closed. The length of time that this clothing system may be worn depends upon specific activity and ambient temperatures. When it is worn under conditions similar to those of these tests, a time limitation of 45 and 90 minutes prevails for 120 and 100F, respectively, when RH is 50% or less. The time difference between the flaps-open and the flaps-closed configurations amounts to only about 7 minutes extended exposure time at 120F, which may not be significant in light of the time needed to accomplish a designated mission. GRA

N77-22807# Omnemii, Inc., Vienna, Va.
MANNED SYSTEM DESIGN USING OPERATOR MEASURES AND CRITERIA Technical Report, 1 Apr. 1975 - 31 Oct. 1976
Edward M. Connelly and N. A. Sloan Oct. 1976 70 p refs
(Contract N00014-75-C-0810)
(AD-A032687; OTR-62-76-1) Avail: NTIS HC A04/MF A01 CSCL 05/8

In existing man-machine systems, the human operator is typically presented a predesigned display, and he must adapt his control techniques in an attempt to optimize overall system performance. Ultimate performance achieved may not rise to the designer's expectation or to the operator's capability because the design process does not account for the operator's adaptability. In this research program, ship control performance of the Officer of the Deck (OOD) was observed and analyzed in a series of simulator experiments involving ship transit and obstacle avoidance. Three types of displays were included in the analysis. OOD control rules, and measures and criteria which describe the control technique used as well as the criteria employed in controlling the ship were derived from the individual performance data. The effect of display type on the measures and criteria which were apparently optimized by the subjects was determined. Author (GRA)

N77-22817*# Connecticut Univ., Storrs.
ANALYSIS OF PILOT-AIRCRAFT PERFORMANCE AND RELIABILITY VIA THE APPLICATION OF MAN-MACHINE MODELS
David L. Kleinman *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 141-156 (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 05H

55 PLANETARY BIOLOGY

Includes exobiology and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

N77-22808*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SYSTEMS RELIABILITY ISSUES FOR FUTURE AIRCRAFT
1975 212 p refs Workshop held at Cambridge, Mass., 18-20 Aug. 1975
(NASA-CP-003) Avail: NTIS HC A10/MF A01 CSCL 12B

The reliability of adaptive controls for future aircraft are discussed. The research, formulation, and experimentation for improved aircraft performance are considered. For individual titles, see N77-22809 through N77-22820.

N77-22809*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF ACTIVE CONTROLS TO CIVIL TRANSPORT AIRCRAFT **c08**
Lawrence W. Taylor, Jr. *In its* Systems Reliability Issues for Future Aircraft 1975 p 9-20 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

The impact of active controls on civil transport aircraft and some of the complex problems involved are described. The approach taken by NASA as part of the Active Control Technology Program is discussed to integrate active controls in the conceptual design phase. It is shown that when handled correctly, active controls improve aircraft performance. M.C.F.

N77-22810*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA AMES ACTIVE CONTROL AIRCRAFT FLIGHT EXPERIMENTS (ACA) PROGRAM **c08**
George Meyer and William R. Wehrend *In its* Systems Reliability Issues for Future Aircraft 1975 p 21-26 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

The objectives of the Ames ACA program are to develop the active control technology (ACT) for short-haul aircraft, to evaluate existing methods, to develop new techniques, and to demonstrate the readiness of the technology in operational environment. Two concepts are basic to ACT: integrated aircraft design and integrated flight-control-system design. Author

N77-22811*# Honeywell, Inc., Minneapolis, Minn.
ADAPTIVE CONTROL LAWS FOR F-8 FLIGHT TESTS **c08**
G. Stein, G. L. Hartmann, and R. C. Hendrick *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 27-49 refs (For primary document see N77-22808 13-59)
(Contracts NAS1-12680; NAS1-13383)
Avail: NTIS HC A10/MF A01 CSCL 01D

An adaptive flight-control-system design for NASA's F-8 Digital Fly-by-Wire research aircraft is described. This design implements an explicit parallel maximum likelihood identification algorithm to estimate key aircraft parameters. The estimates are used to compute gains in simplified quadratic-optimal command augmentation control laws. Design details for the control laws and identifier are presented, and performance evaluation results from NASA Langley's F-8 simulator are summarized. Author

N77-22812*# Lund Univ. (Sweden).
SELF-TUNING REGULATORS **c63**
K. J. Astrom *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 51-68 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

The results of a research project are discussed for self-tuning regulators for active control. An algorithm for the self-tuning regulator is described as being stochastic, nonlinear, time variable, and not trivial. M.C.F.

N77-22813*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FAILURE DETECTION AND CONTROL-SYSTEM RECONFIGURATION: PAST, PRESENT, AND FUTURE **c08**
Raymond C. Montgomery *In its* Systems Reliability Issues for Future Aircraft 1975 p 69-78 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 01D

The history of failure detection and redundancy management in aircraft applications is reviewed. To date, techniques related to that subject have been based mainly on hardware duplication of like components with failure monitoring and switchover or averaging for redundancy management. Specific examples of these techniques are discussed as they have been applied to the NASA F-8 Digital Fly-by-Wire aircraft and are to be applied to the space shuttle vehicle in the near future. Author

N77-22814*# Purdue Univ., Lafayette, Ind.
FACTS AND FICTION OF LEARNING SYSTEMS **c63**
George N. Saridis *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 79-104 refs (For primary document see N77-22808 13-59)
(Grant NSF GK-36607)
Avail: NTIS HC A10/MF A01 CSCL 12B

The methodology that will provide the updated precision for the hardware control and the advanced decision making and planning in the software control is called learning systems and intelligent control. It was developed theoretically as an alternative for the nonsystematic heuristic approaches of artificial intelligence experiments and the inflexible formulation of modern optimal control methods. Its basic concepts are discussed and some feasibility studies of some practical applications are presented. Author

N77-22815*# Stanford Univ., Calif.
STATUS OF DUAL CONTROL THEORY **c63**
Edison Tse *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 105-121 refs (For primary document see N77-22808 13-59)
(Contract N00014-75-C-0738)
Avail: NTIS HC A10/MF A01 CSCL 12B

Theoretical studies of decision making and stochastic processes are discussed. Several approaches are described for an improved performing control method. It is shown that control performance is highly dependent on the knowledge of the unknown parameters in the system. M.C.F.

N77-22816*# Massachusetts Inst. of Tech., Cambridge.
CLOSED-LOOP STRUCTURAL STABILITY FOR LINEAR-QUADRATIC OPTIMAL SYSTEMS **c63**
Poh Kam Wong and Michael Athans *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 123-140 refs (For primary document see N77-22808 13-59)
(Grants NGL-22-009-124; AF-AFOSR-72-2273)
Avail: NTIS HC A10/MF A01 CSCL 12B

An explicit parametrization of a subclass of linear constant gain feedback maps that never destabilize an originally open-loop stable system is presented. These results are used to obtain several new structural stability results for multiinput linear-quadratic feedback optimal designs. Author

N77-22817*# Connecticut Univ., Storrs.
ANALYSIS OF PILOT-AIRCRAFT PERFORMANCE AND RELIABILITY VIA THE APPLICATION OF MAN-MACHINE MODELS **c54**
David L. Kleinman *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 141-156 (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 05H

The present approach to analytic modeling, which utilizes human response theory together with modern control theory, is discussed. Analytic modeling of human performance has progressed to the point where it can be used with some confidence in the design and performance analysis of man-machine systems. An example of its use in helping design a flight director for the hover control of a VTOL vehicle is described. How the method could be used for analysis of human response to system failure is sketched. Author

N77-22818*# Toronto Univ. (Ontario).
RECENT PROGRESS IN MULTIVARIABLE CONTROL c63
W. M. Wonham *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 157-164 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

The major results in structural synthesis and design which are now available in textbook form are discussed which suggests a number of promising directions for future research. Author

N77-22819*# Washington Univ., St. Louis, Mo.
A SUMMARY OF NONLINEAR FILTERING c63
Ian B. Rhodes *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 165-179 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

The formation of nonlinear filtering problems are discussed along with approaches to solving nonlinear filtering problems. An approach to the design and evaluation of the performance of suboptimal filters is presented in terms of upper and lower bounds. M.C.F.

N77-22820*# Massachusetts Inst. of Tech., Cambridge.
A SURVEY OF DESIGN METHODS FOR FAILURE DETECTION IN DYNAMIC SYSTEMS c63
Alan S. Willsky *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 181-207 refs (For primary document see N77-22808 13-59)
(Grant NGL-22-009-124; NsG-1112)
Avail: NTIS HC A10/MF A01 CSCL 12B

A number of methods for detecting abrupt changes (such as failures) in stochastic dynamical systems are surveyed. The class of linear systems is concentrated on but the basic concepts, if not the detailed analyses, carry over to other classes of systems. The methods surveyed range from the design of specific failure-sensitive filters, to the use of statistical tests on filter innovations, to the development of jump process formulations. Tradeoffs in complexity versus performance are discussed. Author

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering*.

N77-22821 California Univ., Berkeley.
TECHNIQUES FOR ANALYZING GRACEFULLY DEGRADING AND STANDBY-SPARING COMPUTER SYSTEMS Ph.D. Thesis
Richard Francis Freitas 1976 204 p
Avail: Univ. Microfilms Order No. 77-4458

A set of techniques are described that comprise an approach to analyzing the performance of a class of fault-tolerant, modular computer systems. Although the approach is applicable to many classes of computer systems, its development was motivated by the desire to study the behavior of a repairable system whose performance varies as modules fail and are repaired; such a system is called a Gracefully Degrading computer system. Therefore, the discussion focuses on the development of techniques for analyzing and comparing the cost-performance behavior of both conceptual and physical implementations of Gracefully Degrading computer systems. In order to develop these techniques, a model and a methodology for evaluating the parameters of the model were developed. Dissert. Abstr.

N77-22822# Advisory Group for Aerospace Research and Development, Paris (France).
MICROPROCESSORS AND THEIR APPLICATIONS
Mar. 1977 159 p refs
(AGARD-LS-87; ISBN-92-835-0191-8) Avail: NTIS HC A08/MF A01

An overview of the microprocessor field is provided that surveys large scale integrated circuit technology for designing computer systems. For individual titles, see N77-22823 through N77-22832.

N77-22823# EMI Electronics Ltd., Hayes (England).
MICROCOMPUTERS AND THEIR APPLICATIONS
R. C. Sloan *In* AGARD Microprocessors and Their Applications Mar. 1977 2 p (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The microprocessor provides the system designer with the capability to design a custon computer system from a small number of low cost building blocks which can be easily interconnected to meet a particular requirement. Such a system has all the advantages normally associated with LSI circuits, namely low volume and power consumption with high reliability. At the present state of development, however, the simple microcomputer is not capable of matching the performance obtainable from a minicomputer and should not be considered as a direct replacement. It is primarily intended to provide either a small computer capability (used directly or as a replicated element of a distributed system) or as a replacement for a hard wired logic system. Since the effective speed of current microprocessor systems is slower than that achievable with hard wired logic, this limits their use to slower speed applications. Author

N77-22824# ERA Ltd., Leatherhead (England).
PROGRAMING LANGUAGES AND BASIC PROGRAMMING TECHNIQUES
C. D. Nabavi *In* AGARD Microprocessors and Their Applications Mar. 1977 7 p (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

Different categories of programming languages are discussed in general terms of their advantages and disadvantages, and their applicability to microprocessor programming is summarized. The emphasis is more on comparing high level versus low level, rather than on comparing different languages at any given level. Also considered are some of the basic techniques used in programming, and it is shown how various desirable features of a program such as clarity, reliability, ease of writing, etc. can be improved by the use of macros, subroutines, and other similar techniques. Some examples of how some of the benefits of structured programming can be introduced into existing assembler languages are given. Author

N77-22825# INTEL Corp. Ltd. (England).
MICROCOMPUTER DESIGN AND FUTURE TRENDS IN MICROCOMPUTER COMPONENTS
In AGARD Microprocessors and Their Applications Mar. 1977 9 p (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The microcomputer offers the engineer a quite dramatic decrease in cost and a great increase in performance and versatility. The reasons for this are obvious; first, the microcomputer is a large scale integrated circuit which is manufactured using mass production techniques which lead to very low cost. Second, the microcomputer is a general purpose digital computer which can provide a system with a versatility which is unobtainable by any other means. Read only memory technology has developed to such an extent that very large computer programs can be housed in read only memories which occupy just one or two integrated circuit chips. It is estimated that by 1980 about 70% of all digital applications will be serviced by microcomputer components. Author

N77-22826# ERA Ltd., Leatherhead (England).
MICROPROCESSOR SUPPORT SOFTWARE
C. D. Nabavi *In* AGARD Microprocessors and Their Applications Mar. 1977 13 p (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The importance of microprocessor support software is often underestimated by the average microprocessor user. A description is given of the support software required to develop a microprocessor based system, how it is used, and what sort of features are considered essential. The programs covered in detail are editors, assemblers, macroprocessors, high level languages, and debugging routines. Several other useful utility programs are briefly mentioned, and the use of simulators is also discussed. Finally a comparison is made of the ways in which such support software

can be run on different systems such as prototyping units, minicomputers, timesharing systems etc. Author

N77-22827# Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
INTERACTION BETWEEN LSI PROCESS TECHNOLOGY AND THE DESIGN OF MICROPROCESSOR SYSTEMS
Miles A. Copeland *In* AGARD Microprocessors and Their Applications Mar. 1977 15 p refs (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

An overview of the interaction between LSI technology and microprocessors is given that includes a survey of the various LSI processes and how they relate to the manufacture of microprocessors. The general nature and significance of an LSI process is outlined, and a description is given of important LSI technologies as well as fundamental LSI circuits. Also considered are aspects of static versus dynamic logic and the significance of speed/power product in a LSI technology. Author

N77-22828# INTEL Corp. Ltd. (England).
MICROPROCESSORS IN PROCESS CONTROL
Howard Kornstein *In* AGARD Microprocessors and Their Applications Mar. 1977 8 p (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The ready availability of low cost digital computing elements in the form of microcomputers is having a significant effect on process control systems of all types, because they remove the two main disadvantages of employing digital computers in control systems and introduce a few advantages of their own. These include a reduction in system cost, improved reliability, adaptability, self diagnosis and calibration, freedom from drift, interactiveness, and improved communications between both system and operator, and between individual system elements. Last, and by no means least, the performance and characteristics of the system are determined by the software. This can easily be changed to modify or update the system at any time. Author

N77-22829# Societe Francaise d'Equipments pour la Navigation Aerienne, Velizy-Villacoublay (France). Dept. of Systems.
THE USE OF MICROPROCESSORS IN CIVIL AVIATION DELAYED FLAP APPROACH SYSTEM
Thuy Phamduc and Daniel Gruaz *In* AGARD Microprocessors and Their Applications Mar. 1977 32 p In FRENCH and ENGLISH (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The delayed flap approach (DFA) system is a typical example of a function which can be performed using microprocessors. It helps to improve the landing procedure for commercial aircraft by reducing noise and saving fuel. It is characterized by complex logic and a calculation function which uses division, multiplication, delays, etc. Author

N77-22830# Royal Signals and Radar Establishment, Malvern (England).
USING A MICROPROCESSOR AS A COMPUTER INTERFACE CONTROLLER
F. E. Withers *In* AGARD Microprocessors and Their Applications Mar. 1977 20 p refs (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

The use of the Plessey MIPROC as an interface controller for the Computer Technology Ltd MODULAR ONE computer is described. The MIPROC is used to control graphic display units equipped with rolling ball and keyboard, and other peripherals. The MODULAR ONE can send commands to the MIPROC which cause the latter to take data from the MODULAR ONE store in processor hesitation mode. Data from two successive 16-bit words are assembled by the MIPROC to form a 24-bit word which is put out to the peripherals on the MYRIAD highways, together with the appropriate control signals which are generated by the MIPROC. Interrupt signals from the peripherals are dealt with by the MIPROC, which interrupts the MODULAR ONE when necessary. Programming of the MIPROC is in assembly code. During development, the MIPROC was operated in its prototyping system, enabling easy debugging of the MIPROC program. It was found to be possible to extend the MIPROC data bus and control signals into the MODULAR ONE cabinet. A comparison between this approach, and the alternative of using hard wired logic, is considered. Author

N77-22831# Carleton Univ., Ottawa (Ontario). Dept. of Electronics.
INTERACTION BETWEEN MICROPROCESSORS AND CUSTOM LSI
Miles A. Copeland *In* AGARD Microprocessors and Their Applications Mar. 1977 11 p refs (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

Custom LSI design fit in the context of microprocessors is considered. A general overview is given of digital machines, under the categories of data processing, timing, and mode circuitry. This was related to hardwired machines, ROM/PROM/PLA based machines, and the stored program machine. The type of circuit is discussed which might interact with the microprocessor but has a specialized structure, finding rationalization in the function to be carried out, or in requirements beyond the microprocessor, such as speed. Some examples of mixed analog/digital signal processing circuits are presented, such as an electrically programmable analog transversal filter and an electrically programmable optical image processor. These circuits operate under the control of a stored program machine. Author

N77-22832# Defence Research Information Centre, Orpington (England).
BIBLIOGRAPHY ON MICROPROCESSORS AND THEIR APPLICATIONS
R. H. Oseman, comp. and R. C. Sloan, comp. (EMI Electronics, Hayes, Engl.) *In* AGARD Microprocessors and Their Applications (For primary document see N77-22822 13-60)
Avail: NTIS HC A08/MF A01

This bibliography has been compiled to provide literature references on microprocessors and their application. The purpose of this lecture series is to: (1) enable systems designers to appreciate the potential and applicability of the technology in military and commercial fields; (2) enable designers responsible for system implementation to appreciate hardware and software design; (3) provide a current update in microprocessor technology for those working in this field both in industry and universities; and (4) provide an update of the techniques and potential for managers. Author

N77-22833*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REPORT ON PHASE 1 OF THE MICROPROCESSOR SEMINAR
1 Apr. 1977 130 p Seminar held at Pasadena, Calif., Oct. 1976
(Contract NAS7-100)
(NASA-CR-152678; JPL-Publ-77-6) Avail: NTIS HC A07/MF A01 CSCL 09B

Proceedings of a seminar on microprocessors and associated large scale integrated (LSI) circuits are presented. The potential for commonality of device requirements, candidate processes and mechanisms for qualifying candidate LSI technologies for high reliability applications, and specifications for testing and testability were among the topics discussed. Various programs and tentative plans of the participating organizations in the development of high reliability LSI circuits are given. Author

N77-22834*# Systems Research Lab., Champaign, Ill.
DIGITAL CONTROLLER DESIGN: CONTINUOUS AND DISCRETE DESCRIBING FUNCTION ANALYSIS OF THE IPS SYSTEM Bimonthly Report
1 Apr. 1977 56 p ref
(Contract NAS8-32358)
(NASA-CR-150248) Avail: NTIS HC A04/MF A01 CSCL 09B

The dynamic equations and the mathematical model of the continuous-data IPS control system are developed. The IPS model considered included one flexible body mode and was hardmounted to the Orbiter/Pallet. The model contains equations describing a torque feed-forward loop (using accelerometers as inputs) which will aid in reducing the pointing errors caused by Orbiter disturbances. Author

N77-22835# Los Alamos Scientific Lab., N. Mex.
MICROPROCESSOR-MINICOMPUTER COMBINATION FOR SIMPLER, MORE FLEXIBLE INSTRUMENTS
D. F. Jones and E. R. Martin 1976 6 p Presented at the IEEE Nucl. Sci. Symp. on Scintillation and Semicond. Counters, New Orleans, 19-22 Oct. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2282; Conf-761006-9) Avail: NTIS HC A02/MF A01

The parallel interface of a microprocessor to a common minicomputer is described. This approach uses existing minicomputer expertise and hardware to open up many new low-quantity micro applications. ERA

N77-22836# Energy Research and Development Administration, Washington, D.C.
SELECTED EXAMPLES OF ERDA RESEARCH IN THE MATHEMATICAL AND COMPUTER SCIENCES
1976 94 p
(ERDA-76-118) Avail: NTIS HC A05/MF A01

A selected sample of ERDA research in the mathematical and computer sciences is presented in the hope that it may offer a variety of insights about the relationship of these fields to energy-related research and development activities. The articles are organized into four topical headings: computer science, mathematical software, applications in science and engineering, and special mathematical topics. ERA

N77-22837# California Univ., Livermore. Lawrence Livermore Lab.
STARLIB: A FORTRAN LIBRARY FOR THE STAR-100 COMPUTER
Carl Schneider, ed, Stan Selback, Bing Young, JoAnn Tobles, and Richard VonHeldt 22 Mar. 1976 64 p refs
(Contract W-7405-eng-48)
(LTSS-306) Avail: NTIS HC A04/MF A01

STARLIB, a subroutine library for the CDC STAR-100, is available at LLL for use in executable codes generated with the FENIX compiler and the LODSTAR loader. It is also available on the CDC 7600 computers at LLL (to users who choose to generate a code with the STAR compiler and LODSTAR loader on the 7600's, and transport it to the STAR-100 for execution). Users of CDC's FORTRAN compiler on the STAR-100 can link to some of STARLIB's subroutines. The basic scalar mathematical subroutines and FORTRAN 1/0 routines are supplied by CDC, but modified to conform to LLL standards; they retain the linkage requirements of the FORTRAN compiler. Routines written at LLL include vector mathematical routines, runtime-1/0--assignment routines, system-oriented routines, and the standard error procedure. ERA

N77-22838# California Univ., Livermore. Lawrence Livermore Lab.
ACQUISITION, STORAGE, RETRIEVAL, DISPLAY, AND UTILIZATION OF COMPUTERIZED DATA IN THE LLL DATA BANK OF PHYSICAL AND CHEMICAL PROPERTIES
Viktor E. Hampel, Eugene A. Henry, Robert W. Kuhn, and Leonard Lyles 1 Jul. 1976 36 p refs Presented at the 5th Bien. Intern. CODATA Conf., Boulder, Colo., 28 Jun. - 2 Jul. 1976
(Contract W-7405-eng-48)
(UCRL-78372-Rev-2; Conf-760643-7) Avail: NTIS HC A03/MF A01

The demand for evaluated numerical data in the physical sciences and engineering, is being met by the managerial research project, which is devoted to the creation of scientific data bases, design and implementation of scientific data management systems, and computer communication and networking. The evolution of this program and the LLL computer systems on which it is based are described. ERA

N77-22839# Sandia Labs., Livermore, Calif. Numerical Applications Div.
MESH GENERATION FOR TWO-DIMENSIONAL REGIONS USING A DVST (DIRECT VIEW STORAGE TUBE) GRAPHICS TERMINAL
V. K. Gabrielson Jul. 1976 27 p refs
(Contract E(29-1)-789)
(SAND-76-8231; Conf-751033-2) Avail: NTIS HC A03/MF A01

The DVMESH code and the use of the Tektronix DVST graphics terminal to prepare mesh data for various two dimensional axisymmetric finite element stress analysis and heat transfer codes are discussed in two parts. The first part is a reproduction of the paper presented at the Conference on Applications of Computer Graphics in Engineering at Langley Research Center on October 2, 1975. The second part is a user's manual for the code's implementation. ERA

N77-22840# Brookhaven National Lab., Upton, N.Y.
FILE MANAGEMENT FOR EXPERIMENT CONTROL PARAMETERS WITHIN A DISTRIBUTED FUNCTION COMPUTER NETWORK
F. W. Stubblefield Oct. 1976 11 p refs Presented at the IEEE Nuclear Sci. Symp., New Orleans, 20-22 Oct. 1976 Submitted for publication
(Contract EY-76-C-02-0016)
(BNL-21885; Conf-761006-14) Avail: NTIS HC A02/MF A01

An attempt to design and implement a computer system for control of and data collection from a set of laboratory experiments reveals that many of the experiments in the set require an extensive collection of parameters for their control. The operation of the experiments can be greatly simplified if a means can be found for storing these parameters between experiments and automatically accessing them as they are required. A subsystem for managing files of such experiment control parameters is discussed. ERA

N77-22841# Michigan Univ., Ann Arbor. Systems Engineering Lab.
DATA FLOW CONSIDERATIONS IN IMPLEMENTING A FULL MATRIX SOLVER WITH BACKING STORE ON THE CRAY-1 Interim Report
D. A. Orbits and D. A. Calahan 1 Sep. 1976 32 p refs
(Grant AF-AFOSR-2812-75; AF Proj. 2304)
(AD-A033378; AFOSR-76-1212TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

Techniques for the solution of full systems of simultaneous equations represent an important algorithm class for vector processors. This report considers the data flows involved in solving a full equation system on the Cray-1. This involves study of the I/O and memory-processor path traffic vis-a-vis the capabilities of the Cray-1 to support it. The I/O is found to present problems for small and large systems. Using algorithms proposed in the report, the memory-processor path is shown to have excess bandwidth. Suggestions are made for utilizing this bandwidth to increase the arithmetic operation rate by modifying and expanding the processor architecture. Author (GRA)

N77-22842# Defense Documentation Center, Alexandria, Va.
COMPUTERS IN INFORMATION SCIENCES: COMPUTER PROCESSING OF ANALOG DATA Report Bibliography, Jan. 1968 - Mar. 1976
Nov. 1976 326 p Supersedes DDC-TAS-73-7
(AD-A033250; DDC/BIB-76/10; DDC-TAS-73-7) Avail: NTIS HC A15/MF A01 CSCL 09/2

This bibliogrphy contains 255 unclassified and unlimited citations primarily dealing with computers in information sciences computer processing of analog data. Corporate Author-Monitoring Agency, Subject, Title, and Personal Author are provided. Author (GRA)

N77-22843# New York Univ., N. Y. Div. of Applied Science.
COMPUTER GRAPHICS AND IMAGE PROCESSING Final Report, 1 Jun. 1969 - 31 Dec. 1975
Herbert Freeman Aug. 1976 28 p
(Contract N00014-75-C-0572)
(AD-A032807; CRL-47) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report describes the research performed under the contract during the period 1 June 1969 - 31 December 1975. The research had as its objective the development of effective computer techniques for analyzing and manipulating line-drawing data with a digital computer. The specific research activities carried out under the contract are summarized in terms of abstracts of technical reports and journal articles. GRA

N77-22844# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.
A PROCESSOR UTILIZATION MODEL FOR A MULTIPROCESSOR COMPUTER SYSTEM
U. Narayan Bhat and Richard E. Nance (Virginia Polytech. Inst. and State Univ.) Sep. 1976 33 p refs
(Contract N00014-75-C-0517)
(AD-A032660; IEOR-76012) Avail: NTIS HC A03/MF A01 CSCL 09/2

In this paper, a processor utilization model for a simplified multi-processor computer system is developed using a G/M/s/N queueing system model. The mathematical model is based on the busy period analysis, and two utilization measures are derived: (1) processor utilization (the fraction of processor occupation time during a busy cycle), and (2) system utilization (the fraction of actual utilization time for all processors). Experimentation with the computational model reveals the sensitivity of the model to variability in the arrival process. Author (GRA)

N77-22845# Army Missile Command, Redstone Arsenal, Ala. Systems Analysis Office.
AN INTERACTIVE GRAPHICS PROGRAM FOR DISPLAY OF INPUT DATA TO TACOS SCENARIOS Final Report
Lewis R. Paceley and Walter P. Batson, Jr. Aug. 1976 16 p
(AD-A031660; C-TM-76-4) Avail: NTIS HC A02/MF A01 CSCL 09/2

TACOS UTILITY GRAPHICS PROGRAM (TUG-P) is an interactive TACOS support program written in CDC EXTENDED FORTRAN. The program is designed to display graphically, using standard TACOS input data, the FEBA, site, and track information used in TACOS scenarios. TUG-P is presently operational on the CDC6600 in conjunction with a TEKTRONIX 4014/1 graphics terminal and associated hardcopy unit. TUG-P can be easily modified for use with any system having TEKTRONIX ADVANCED GRAPHICS II capabilities. GRA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N77-22846*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ANOPP PROGRAMMER'S REFERENCE MANUAL FOR THE EXECUTIVE SYSTEM
Ronnie E. Gillian, Christine G. Brown, Robert W. Bartlett (Control Data Corp.), and Patricia H. Baucom (Control Data Corp.) Apr. 1977 380 p refs
(NASA-TM-X-74029) Avail: NTIS HC A17/MF A01 CSCL 09B

Documentation for the Aircraft Noise Prediction Program as of release level 01/00/00 is presented in a manual designed for programmers having a need for understanding the internal design and logical concepts of the executive system software. Emphasis is placed on providing sufficient information to modify the system for enhancements or error correction. The ANOPP executive system includes software related to operating system interface, executive control, and data base management for the Aircraft Noise Prediction Program. It is written in Fortran IV for use on CDC Cyber series of computers. Author

N77-22847*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PARALLEL COMPILATION: A DESIGN AND ITS APPLICATION TO SIMULA 67
Richard L. Schwartz 1 Feb. 1977 46 p refs
(Contract NAS7-100)
(NASA-CR-152680; JPL-Publ-77-4) Avail: NTIS HC A03/MF A01 CSCL 09B

A design is presented for a parallel compilation facility for the SIMULA 67 programming language. The proposed facility allows top-down, bottom-up, or parallel development and integration of program modules. An evaluation of the proposal and a discussion of its applicability to other languages are then given. Author

N77-22848*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SAVLOC, COMPUTER PROGRAM FOR AUTOMATIC CONTROL AND ANALYSIS OF X-RAY FLUORESCENCE EXPERIMENTS
Regis F. Leonard Washington Apr. 1977 45 p refs
(NASA-TN-D-8398; E-9000) Avail: NTIS HC A03/MF A01 CSCL 09B

A program for a PDP-15 computer is presented which provides for control and analysis of trace element determinations by using X-ray fluorescence. The program simultaneously handles data accumulation for one sample and analysis of data from previous samples. Data accumulation consists of sample changing, timing, and data storage. Analysis requires the locating of peaks in X-ray spectra, determination of intensities of peaks, identification of origins of peaks, and determination of a real density of the element responsible for each peak. The program may be run in either a manual (supervised) mode or an automatic (unsupervised) mode. Author

N77-22849# Los Alamos Scientific Lab., N. Mex.
REPORT ON THE APPLICATION OF STATISTICAL TECHNIQUES TO THE ANALYSIS OF COMPUTER CODES
Michael D. McKay, W. J. Conover (Texas Tech. Univ., Lubbock), and David E. Whiteman Aug. 1976 15 p refs
(Contract W-7405-eng-36)
(LA-NUREG-6526-MS) Avail: NTIS HC A02/MF A01

Two types of sampling plans are presented as alternatives to simple random sampling in Monte Carlo studies. These plans are shown to be improvements over simple random sampling with respect to the variance of a class of estimators which include the sample mean and the sample cumulative distribution function. The partial rank correlation coefficient is presented as a measure of sensitivity. Examples and test cases are included. ERA

N77-22850# Lockheed Missiles and Space Co., Palo Alto, Calif.
OPTIMIZATION OF FINITE ELEMENT GRIDS BY DIRECT ENERGY SEARCH Interim Report
Carlos A. Felippa 1976 10 p refs Repr. from Appl. Math. Modelling, v. 1, Sep. 1976 p 93-95
(Contract F44620-71-C-0109; AF Proj. 2304)
(AD-A033460; AFOSR-76-1300TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

One of the possible approaches to the reduction of computational costs in finite element analysis is the selection of 'optimal grids', which produce the 'best' answers, in the sense of minimizing a discretization error measure, for a fixed level of computational effort. The grid optimization problem is studied in the case of grids of similar topology having a fixed number of degrees of freedom per node. A general formulation based on weighted-residual error measures is specialized to field problems associated with a positive-definite energy functional, the minimization of which, with respect to variable node locations, is adopted as a grid optimality criterion. The problem is then embedded in the framework of the general nonlinear programming problem, and desirable computational features of candidate search algorithms are described. GRA

N77-22851# Defense Systems Management School, Fort Belvoir, Va.
THE ROLE OF AN INDEPENDENT SOFTWARE VALIDATION AGENCY
Clyde R. Magill, Jr. May 1976 42 p refs
(AD-A033616) Avail: NTIS HC A03/MF A01 CSCL 09/2

New systems containing software development will continue to increase the Department of Defense investment in software. The cost of the software programs will continue to increase in relationship to the cost of hardware components of a system as more complex systems are developed in the future. This importance is due primarily to the cost of software test and evaluation. The testing phase of computer program design and development represents 50 percent or more of the total computer software costs. This report evaluates the role of an independent test agency and provides an updated and realistic set of tasks for consideration by these agencies. Author (GRA)

N77-22852# Yale Univ., New Haven, Conn. School of Organization and Management.
NONDERIVATIVE OPTIMIZATION Final Report, 15 Apr. 1974 - 31 Aug. 1976
Robert Mifflin 8 Nov. 1976 6 p refs
(Grant AF-AFOSR-2695-74)
(AD-A032924; AFOSR-76-1187TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

The research supported under this grant has led to new and efficient methods for solving nonlinear optimization problems involving functions that are not everywhere differentiable. Author (GRA)

N77-22853# Stanford Univ., Calif. Systems Optimization Lab.
ROBUST IMPLEMENTATION OF LEMKE'S METHOD FOR THE LINEAR COMPLEMENTARY PROBLEM
J. A. Tomlin Sep. 1976 17 p refs
(Contracts N00014-75-C-0865; DAAC29-74-C-0034; E(04-3)-326; Grant NSF DCR-75-04544)
(AD-A033433; SOL-76-24) Avail: NTIS HC A02/MF A01 CSCL 12/2

This note discusses techniques for implementing Lemke's algorithm for the linear complementarity problem in a numerically robust way as well as a method for recovering from loss of feasibility or singularity of the basis. This recovery method is valid for both positive semi-definite M matrices and those with positive principal minors. It also allows a user to start from an advanced basis for such problems. Author (GRA)

N77-22854# Stanford Univ., Calif. Systems Optimization Lab.
EFFICIENT LINEAR SEARCH ALGORITHMS FOR THE LOGARITHMIC BARRIER FUNCTION
Walter Murray (Natl. Phys. Lab., Teddington, England) and Margaret H. Wright Sep. 1976 55 p refs
(Contracts N00014-75-C-0865; E(04-3)-326; Grant NSF DCR-75-04544)
(AD-A033432; SOL-76-18) Avail: NTIS HC A04/MF A01 CSCL 12/2

Linear search algorithms are developed for use when minimizing logarithmic barrier functions, whose one-dimensional behavior is in general modeled poorly by the low-order polynomial approximations of standard linear search procedures. The new methods are based on special approximating functions with a logarithmic singularity, and are designed to utilize the same information as procedures based on special approximating functions with a logarithmic singularity, and are designed to utilize the same information as procedures based on quadratic or cubic polynomials. Although the parameters of the special approximating functions depend nonlinearly on the available data, the determination of the parameters requires little additional work in comparison with polynomial fits. Use of the special approximating functions has led to a significant improvement in efficiency when minimizing logarithmic barrier functions, where efficiency is measured by the number of function (or function and gradient) evaluations required for termination of each linear search. (GRA)

N77-22855# Naval Research Lab., Washington, D. C.
THE CODASYL DATA DESCRIPTION LANGUAGE: STATUS AND ACTIVITIES
Frank A. Manola 22 Nov. 1976 34 p refs
(RF21211401)
(AD-A033401; NRL-8038) Avail: NTIS HC A03/MF A01 CSCL 09/2

The CODASYL Data Description Language Committee (DDLC) was instituted to take the work of the CODASYL Data Base Task Group (DBTG), as reflected in its April 1971 Report as base and to develop from it specifications for a host-language independent data description language (the schema DDL). The DDLC held its first meeting November 30, 1971. Various changes have been made in the schema DDL language specifications to reflect the development of data base systems technology. This report describes briefly the current status and activities of the CODASYL DDLC, the status of the DDLC language specifications, and future directions for DDLC work. GRA

N77-22856# Northwestern Univ., Evanston, Ill. Dept. of Industrial Engineering and Management Sciences.
OPTIMALITY CONDITIONS IN GENERALIZED GEOMETRIC PROGRAMMING
Elmor L. Peterson 20 May 1976 18 p refs
(Grant AF-AFOSR-2516-73)
(AD-A033366; AFOSR-76-1233TR; Paper-221) Avail: NTIS HC A02/MF A01 CSCL 12/1

Generalizations of the Kuhn-Tucker optimality conditions are given, as are the fundamental theorems having to do with their necessity and/or sufficiency. Author (GRA)

N77-22857# Rome Air Development Center, Griffiss AFB, N.Y.
PRESENTATIONS AT THE RADC/ARPA INVITATIONAL DOD/INDUSTRY CONFERENCE ON SOFTWARE VERIFICATION AND VALIDATION
5 Aug. 1976 424 p refs Conf. held at Syracuse, N. Y., 3-5 Aug. 1976 Sponsored in part by ARPA
(AD-A033625; MTR-3232) Avail: NTIS HC A18/MF A01 CSCL 09/2

Original and previously published papers are presented that define the state-of-the-art in software verification and validation. The papers, in general, cover the spectrum from large scale software system verification through working validation tools to Symbolic Execution and the theoretical proof of correctness advances. Author (GRA)

N77-22858# BDM Corp., El Paso, Tex.
ON THE DESIGN OF AN EXECUTIVE PROGRAM AND A COMMON SIMULATION LANGUAGE TRANSLATOR FOR A SYSTEMS ANALYSIS PROGRAM Final Report
Allan F. Malmberg Sep. 1976 235 p refs
(Contract F29601-74-C-0017)
(AD-A033296; BDM/E-47-75-F-0017; AFWL-TR-75-272) Avail: NTIS HC A11/MF A01 CSCL 09/2

Development work towards the realization of an executive program and language translator for use with a systems analysis program for vulnerability assessment is described. The executive program permits sequencing of arbitrary application modules on a stand alone basis and provides for exchange of data between modules. An Executive Control Language is described for programming the actions of the executive program. The Common Simulation Language is described which incorporates many of the features of the NET-2, SCEPTRE, and CIRCUS-2 simulation languages. Techniques and difficulties associated with the automated translation of Common Simulation Language text to the equivalent NET-2, SCEPTRE, and CIRCUS-2 language texts are discussed. Programs for automatically generating LR(k) parsers and multi-scanner lexical analyzers are also described. Author (GRA)

N77-22859# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
SLICE 75, A COMPUTER PROGRAM FOR LARGE, SYMMETRIC EIGENVALUE PROBLEMS Final Report
Paul S. Jensen Sep. 1976 81 p refs
(Contract F44620-71-C-0109)
(AD-A032664; LMSC-D508885; AFOSR-76-1144TR) Avail: NTIS HC A05/MF A01 CSCL 09/2

SLICE 75 is a computer program for eigenvalue and eigenvector analysis of the generalized, symmetric problem Sx - Mx, where M is non-negative definite. It is particularly suited for obtaining a few select eigenvalues and eigenvectors of a large, sparse system of equations. Comprehensive documentation of SLICE 75 is provided including detailed descriptions of the mathematical, numerical, and implementation systems used. Operational procedures are also discussed and illustrated with output from sample program executions. SLICE 75 uses a general storage management system AID and a number of utility programs which are documents in the Appendixes of this report. (GRA)

N77-22860# Naval Underwater Systems Center, Newport, R.I.
THE DESIGN AND DEVELOPMENT OF A GENERAL CROSS ASSEMBLING CAPABILITY
Ronald P. Kasik and Thomas A. Galib 8 Nov. 1976 119 p refs
(AD-A032671; NUSC-TD-4994) Avail: NTIS

HC A06/MF A01 CSCL 09/2

Conventional techniques used to write cross assemblers have been time consuming, three to six months to develop, and lacking in capability, i.e., macro capability, conditional assembly, and floating point representation. This thesis describes the design and development of a general cross assembling capability which reduces development time to a matter of weeks, or even days, while providing macro and conditional assembly capabilities and floating point representation. This capability is provided by a specially designed macro processor. The macro processor provides special directives enabling it to provide for the general cross assembling capability. Furthermore, the development of the macro processor proceeded in a direction aimed at making it a portable software product. As such, its successful implementation can prove to be cost effective for potential mini and micro computer users. (GRA)

N77-22861# Stanford Univ., Calif. Systems Optimization Lab.

ON A CLASS OF CONCAVE-SEPARABLE INTEGER PROGRAMS

Gary A. Kochman Sep. 1976 19 p refs

(Contracts F44620-74-C-0079; N00014-76-C-0418; DAAC29-74-C-0034)

(AD-A033313; SOL-76-22; AFOSR-76-1218TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

A class of nonlinear integer programs is introduced. Problems in this class are characterized by a concave and separable objective function subject to a set of linear constraints. It is shown how by suitably modifying the objective function, the theory of separability in linear programming can be applied to derive efficient solution procedures for problems falling in this class. This work unifies and extends several results previously obtained independently in the literature. Two illustrative applications are discussed in some detail, and specified algorithms are presented for these examples. Author (GRA)

N77-22862# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

EFFICIENT MULTIPLE PROCESSOR COORDINATION Ph.D. Thesis

Bob E. Baker Nov. 1976 236 p refs

(AD-A032803; DS/EE/76-1) Avail: NTIS HC A11/MF A01 CSCL 09/2

In recent years, the concept of level-structured system organization has received growing acceptance as a computer operating system design technique. This approach treats the hardware of a computing system as the bottom level of a multilevel system which will be built up one level at a time. Each level creates an abstraction of the next lower level by implementing a new virtual machine which provides some features not previously available. This dissertation presents efficient solutions to certain problems of processor interaction which must be faced by the system designer at the lower levels of a strictly level-structured operating system. A loop-free algorithm is developed which solves Dijkstra's critical section problem, based on a rudimentary processor delay mechanism and the instruction set of a typical large computer of conventional architecture (DECsystem-10). A completely rigorous proof of the algorithm's correctness is given. The algorithm is used as the basis of a systematic procedure for obtaining efficient solutions to general processor coordination problems. The procedure is illustrated by solving several of the well-known reader/writer problems and a more complex new problem, the producer/consumer/distributor problem, which involves simultaneous use of several independent shared resources. Author (GRA)

N77-22863# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.

AUTOMATIC GENERATION OF BUSINESS DATAPROCESSING PROGRAMS FROM A NON-PROCEDURAL LANGUAGE Ph.D. Thesis

N. Adam Rin 20 Oct. 1976 485 p refs

(Contract N00014-76-C-0416)

(AD-A032638; Rept-76-05) Avail: NTIS MF A01 CSCL 09/2

The rising cost of software development has motivated research on the automation of parts of the software development process. Towards that objective, this dissertation presents a non-procedural language called MODEL to describe desired programs of an information processing system. The dissertation also describes a software system that automatically generates conventional business data processing programs from specifications in that language. Author (GRA)

N77-22864# Hammer (Michael), Newton, Mass.

APPROACHES TO SOLVING THE SOFTWARE PROBLEM: SOFTWARE ENGINEERING AND AUTOMATIC PROGRAMMING Final Report

Michael Hammer and Barbara Liskov 26 May 1976 50 p refs

(Contract N00014-76-M-0024)

(AD-A032814) Avail: NTIS HC A03/MF A01 CSCL 09/2

This document provides a broad thematic overview of proposed approaches to solving the software problem. GRA

N77-22865# Mathematical Applications Group, Inc., Elmsford, N. Y.

A COMPUTER SIMULATION SYSTEM FOR THE PRODUCTION OF REALISTIC PHOTOGRAPHS OF TERRESTRIAL SCENES

Joan Brooks, Robert Goldstein, and Herbert A. Steinberg Jul. 1976 106 p refs

(Contract DAAG53-76-C-0043)

(AD-A032111; P-7126) Avail: NTIS HC A06/MF A01 CSCL 08/2

This work develops a computer simulation system for large scale terrestrial scenes. The previous efforts have produced independent models for solid targets, camouflage nets, terrain, and vegetation ground cover. The present effort has produced automatic generation of vegetation input, improvements in the efficiency of the vegetation model, and increased flexibility of the terrain model and has welded the independent models into a single system capable of producing shadowed photographs of all or any part of a composite scene. The system has been successfully demonstrated by the production of a high quality photograph of a simulated test site. GRA

N77-22866# Air Force Avionics Lab., Wright-Patterson AFB, Ohio.

A USERS GUIDE TO COMPUTER PROGRAMS SIAAP AND INFACE Final Report, 2 Jan. - 30 Dec. 1975

John E. Camp Jul. 1976 371 p refs

(AD-A031732; AFAL-TR-76-120) Avail: NTIS HC A16/MF A01 CSCL 09/2

This report contains the documentation necessary to utilize the capabilities of program SIAAP (Standard Interface Applicability Analysis Program) and its supporting programs. This program supplies a given set of subsystem interface modules and LRU (Line Replaceable Units) locations to a defined system of signals and evaluates time effectiveness with which the thus defined multiplex system can interface the signaling requirements. Examples are given on the results of these programs and the coding of signal data. Program SIAAP consists of one main program and ten subprograms. There are four other programs which support SIAAP. This program applies a given set of subsystem interface modules (SSIM's) and LRU assignments to a defined set of signals and evaluates in tabular form the effectiveness with which the multiplex system can interface the signal set. Various evaluation indicators can be output as desired for analysis of the achieved fit. In addition, a list of the signals not matched with an interface is provided, along with a summary count of the unmatched signals. Each signal with its essential characteristics is written in a format compatible with the standard 80-column card. Author (GRA)

N77-22867# National Cancer Inst., Bethesda, Md. Image Processing Unit.

LPTSPL: A LINEPRINTER SPOOLER FOR THE OS/8 PRINT CUSP Final Technical Report

Gerson Grosfeld and Peter F. Lemkin 14 Apr. 1976 8 p Sponsored by HEW

(PB-261533/4; NCI/IP-76/04; TR-24) Avail: NTIS HC A02/MF A01 CSCL 09B

LPTSPL lists up to 5 files specially formatted on a lineprinter or other output device. The program is called through the CCL

Print command using the command decoder. Formatted output contains, on each page, a page header consisting of input file name, date, and page number followed by the file text with consecutive line numbers. Several command decoder and text-imbedded switches are available for greater operating flexibility. GRA

N77-22868# National Cancer Inst., Bethesda, Md. Image Processing Unit.
MAG10: A PDP8/e FILE BASED MAGTAPE UTILITY Final Report
Peter F. Lemkin 4 Dec. 1976 9 p
(PB-261534/2; NCI/IP-76/05; TR-12) Avail: NTIS HC A02/MF A01 CSCL 09B

MAG10 is a PDP8/e utility program which uses the command decoder to specify commands to manipulate and transfer files between the MTAO and OS8 devices. The magtape files have associated file headers permitting access of particular files by name. Using the 9-track tape mode, it uses either the TC58 or TM8e magtape controllers for the TU20-10 drives. GRA

N77-22869# National Cancer Inst., Bethesda, Md. Image Processing Unit.
BMOMNI: FORTRAN INTERFACE PROGRAM FOR THE RTPP BUFFER MEMORY, QUANTIMET AND CONTROL DESK Final Report
Peter F. Lemkin 14 Dec. 1976 10 p refs
(PB-261538/3; NCI/IP-76/09; TR-23) Avail: NTIS HC A02/MF A01 CSCL 09B

BMOMNI is a low level graphics and hardware control package for the Real Time Picture Processor (RTPP) written in FORTRAN 2. GRA

N77-22870# National Cancer Inst., Bethesda, Md. Image Processing Unit.
PROC10: AN IMAGE PROCESSING SYSTEM FOR THE PDP-10: OPERATION AND DESCRIPTION Final Technical Report
Peter F. Lemkin, Bruce Shapiro, Richard Gordon, and Lewis Lipkin 16 Dec. 1976 53 p refs
(PB-261535/9; NCI/IP-76/06; TR-8) Avail: NTIS HC A04/MF A01 CSCL 09B

PROC10 can manipulate picture, mask, boundary, boundary transform, and computing window data structures. PROC10 provides many operations on and between these data structures. Images and boundaries may be displayed on several different types of terminals including the DEC GT40, Tektronix 4012 and 4023 terminals, and ASR33. GRA

N77-22871# National Cancer Inst., Bethesda, Md. Image Processing Unit.
BUFFER MEMORY MONITOR SYSTEM FOR INTERACTIVE IMAGE PROCESSING Final Technical Report
Peter F. Lemkin 14 Dec. 1976 29 p refs
(PB-261536/7; NCI/IP-76/07; FTR-21) Avail: NTIS HC A03/MF A01 CSCL 09B

BMON2 is a PDP8/e image processing system running on the image processing unit's real time picture processor. It uses the PDP8/e, quantimet, axiomat microscope with stage, focus and zoom stepping motor control, control desk, GraphPen tablet, and buffer memory parts of the RTPP. Control of the system is by either the teletype or control desk. Teletype commands are entered via the OS8 command decoder. Over 70 operations are available with most operations being performed in microns for user convenience. Teletype commands may be dynamically assigned to the 12 command keys on the control desk which may be saved and restored from disk files. GRA

N77-22872# National Cancer Inst., Bethesda, Md. Image Processing Unit.
GPPASM: A PDP8/e ASSEMBLER FOR THE GENERAL PICTURE PROCESSOR Final Technical Report
Peter F. Lemkin, Bruce Shapiro, Mort Schultz, Lewis Lipkin, and George Carman 15 Dec. 1976 45 p refs
(PB-261537/5; NCI/IP-76/08; TR-16) Avail: NTIS HC A03/MF A01 CSCL 09B

GPPASM is intended to assemble RTPP source code produced by the MAINSAIL complier on the DPD-10 as well as microinstructions for the microinstruction control program memory of the GPP. Binary output files may then be loaded into the GPP by the GPPLDR program. GRA

N77-22873# Texas Univ., Austin. Applied Research Labs.
THE CORRELATION BEAMFORMER -- A METHOD OF BEAM CONTROL WITHOUT THE USE OF TIME DELAY OR PHASE SHIFT NETWORKS Final Technical Report, 29 Nov. 1973 - 31 Dec. 1975
David A. Smith Oct. 1976 199 p refs
(Contracts N61339-74-C-0031; N61339-76-C-0014)
(AD-A033113; ARL-TR-76-2-Rev) Avail: NTIS HC A09/MF A01 CSCL 17/1

The classic beamforming algorithm involves the process of 'phasing-to-plane'. This report presents a method of beamforming which does not require the phasing-to-a-plane step, and therefore can be implemented without the use of time delay or phase shift network. The study was restricted to cylindrical or circular arrays of equally spaced sensor elements, although the method appears to be equally applicable for other geometries. Since no general closed form solution for the required shading coefficients is available, a set of shading coefficient selection algorithms are developed and presented along with the resulting beam pattern performance. Studies of the bandwidth, elevation beam patterns, and the effects of construction errors, as well as methods of implementing the beamformer, are reported. GRA

N77-22874# Stanford Univ., Calif. Systems Optimization Lab.
PROGRAMMER'S GUIDE TO LCPL: A PROGRAM FOR SOLVING LINEAR COMPLEMENTARITY PROBLEMS BY LEMKE'S METHOD
J. A. Tomlin Oct. 1976 58 p refs
(Contracts N00014-75-C-0865; DAAC29-74-C-0034)
(AD-A033321; SU-SOL-76-25) Avail: NTIS HC A04/MF A01 CSCL 12/1

This report gives programmers information and documentation for LCPL--an efficient robust program for solving Linear Complementarity Problems by Lemke's Method. Author (GRA)

62 COMPUTER SYSTEMS

Includes computer networks.

N77-22875# California Univ., Livermore. Lawrence Livermore Lab.
SELECT: A SYMBOL AND PATTERN SEARCHING PROGRAM
D. Lai 6 Jul. 1976 13 p
(Contract W-7405-eng-48)
(UCID-30139) Avail: NTIS HC A02/MF A01

SELECT provides a very simple means of interactively searching and printing entries in an ASCII disk file which contains up to five user-selected symbols and/or patterns. ERA

N77-22876# Massachusetts Inst. of Tech., Cambridge.
IMPROVING INFORMATION STORAGE RELIABILITY USING A DATA NETWORK M.S. Thesis
Arthur Jay Benjamin Oct. 1976 140 p refs
(Contract N00014-75-C-0661; ARPA Order 2095)
(AD-A033394; MIT/LCS/TM-78) Avail: NTIS HC A07/MF A01 CSCL 09/2

Backup and recovery methods using magnetic tapes are common in computer utilities, since information stored on-line is subject to damage. The serial access nature of the tape medium severely restricts the flexibility and simplicity of accessing and managing the stored data. A method using a data network is described, to present a backup mechanism which takes advantage of a large, inexpensive, random access remote data storage facility to provide data access and management functions that are more flexible than those provided by a traditional backup facility. Although data transfer rates will be reduced, data access and management will be simplified, and system availability will be improved. The work described is based on a network backup facility built for the Multics computer utility, using the ARPA-net. GRA

N77-22877# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE ARPANET NETWORK CONTROL CENTER PROGRAM
Nov. 1976 87 p
(Contracts DAHC15-69-C-01; F080606-73-C-0027)
(AD-A033351/; Techn. Inform-90) Avail: NTIS HC A05/MF A01 CSCL 09/2

This report describes the Network Control Center (NCC) program used in the ARPA Network. The information in the report explains the functions, structure, and major routines of the NCC program in detail, with diagrams included where helpful. The ARPA Network provides a capability for geographically separated computers, called Hosts, to communicate with each other via common-carrier circuits. Each Host is connected to a small local computer called an Interface Message Processor (IMP); each IMP is connected to several other IMPs via wideband communications lines. The IMPs, most of which are virtually identical, are programmed to store and forward messages to their neighbor IMPs based on address information contained in each message. GRA

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N77-22878*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
ON THE OPTIMAL MINIMUM ORDER OBSERVER-BASED COMPENSATOR AND THE LIMITED STATE VARIABLE FEEDBACK CONTROLLER
Baldomero Llorens-Ortiz Sep. 1976 143 p refs
(Grant NGL-22-009-124)
(NASA-CR-152695; ESL-R-732) Avail: NTIS HC A07/MF A01 CSCL 12B

Four design problems are considered: two on the optimal minimum order observer-based compensator design and two on the optimal limited state variable feedback controller. The problem of designing an optimal discrete time linear time-invariant observer-based compensator for the regulation of an n dimensional linear discrete time time-invariant plant with m independent outputs is considered. This is a stochastic design problem to the extent that the initial plant state is assumed to be a random vector with known first and second order statistics. The compensator parameters are obtained by minimizing the expectation, with respect to the initial conditions, of the standard cost, quadratic in the state and control vectors with the inclusion of cross terms. Author

N77-22879# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
REPRESENTATION AND RECOGNITION OF THE SPATIAL ORGANIZATION OF THREE DIMENSIONAL SHAPES
D. Marr and H. K. Nishihara Aug. 1976 57 p refs
(Contract N00014-75-C-0643)
(AD-A031882; AI-M-377) Avail: NTIS HC A04/MF A01 CSCL 06/4

A method is given for representing 3-D shapes. It is based on a hierarchy of stick figures (called 3-D models), where each stick corresponds to an axis in the shape's generalized cone representation. Although the representation of a complete shape may contain many stick figures at different levels of detail, only one stick figure is examined at a time while the representation is being used to interpret an image. By thus balancing scope of description against detail, the complexity of the computations needed to support the representation is minimized. The method requires (a) a database of stored stick figures; (b) a simple device called the image-space processor for moving between object-centered and viewer-centered coordinate frames; and (c) a process for relaxing a stored model onto the image during recognition. The relation of the theory to mental rotation phenomena is discussed, and some critical experimental predictions are made. Author (GRA)

N77-22880# Louisiana Office of State Planning, Baton Rouge. Dept. of Computer Science.
ON THE FLEXIBILITY OFFERED BY STATE FEEDBACK IN MULTIVARIABLE SYSTEMS BEYOND CLOSED-LOOP EIGENVALUE ASSIGNMENT Interim Report
Bruce C. Moore Apr. 1976 23 p refs
(Grant AF-AFOSR-2580-74)
(AD-A033056; Control-Systems-7609; AFOSR-76-1179TR)
Avail: NTIS HC A02/MF A01 CSCL 12/2

A characterization is given for the class of all closed loop eigenvector sets which can be obtained with a given set of distinct closed loop eigenvalues using state feedback. It is shown, furthermore, that the freedom one has in addition to specifying the closed loop eigenvalues is precisely this: to choose one set of closed loop eigenvectors from this class. Included in the proof of this result is an algorithm for computing the matrix of feedback gains which gives the chosen closed loop eigenvalues and eigenvectors. A design scheme based on these results is presented which gives the designer considerable freedom to choose the distribution of the modes among the output components. One interesting feature is that the distribution of a mode among the output components can be varied even if the mode is not controllable. Author (GRA)

N77-22881# Yale Univ., New Haven, Conn. Becton Center.
A NEW ADAPTIVE OBSERVER
Kumpati S. Narendra and Lena S. Valavani Oct. 1976 19 p refs
(Contract N00014-67-A-0097-0020)
(AD-A033122; TR-74) Avail: NTIS HC A02/MF A01 CSCL 12/1

An adaptive observer is defined as one which estimates the state variables and parameters of an unknown stable linear time-invarient plant from its input-output data. At the present time, there are two distinct approaches to the design of adaptive observers for a plant whose input-output behavior can be represented by an n-th order differential equation. In the first approach, the observer is of the same order as the plant and is referred to as a minimal (order) observer. Using the second approach, a non-minimal observer of order (2n-1) is obtained. Minimal observers are considerably more difficult to synthesize than non-minimal observers and require the generation of additional signals for the stabilization of the adaptive loop. However, they have the advantage of yielding simultaneously both parameter and state estimates of the plant. Non-minimal observers are considerably simpler in structure, both the n state variables of the plant have to be estimated from the available (2n-1) state variables of the observer. In this brief paper, a new observer is proposed which appears to combine the advantages of the two types of observers described above. With this observer, the parameter estimates of the plant are directly obtained with a structure which is no more complex than that of a non-minimal observer which is widely used at the present time. The parameter estimates are simultaneously used to determine directly the state estimates of the plant. Under certain conditions, the new observer has a faster rate of convergence than the observers known at present, which makes it particularly attractive for use in the control problem. GRA

N77-22882# Massachusetts Inst. of Tech., Cambridge. Lab. for Computer Science.
A SYSTEM TO PROCESS DIALOGUE Progress Report
Gretchen P. Brown Oct. 1976 53 p refs
(Contract N00014-75-C-0661)
(AD-A033276; MIT/LCS/TM-79) Avail: NTIS HC A04/MF A01 CSCL 17/2

This is a progress report on work toward an English language interface for expert systems. A framework for handling mixed-initiative English dialogue in a console session environment is discussed, with special emphasis placed on recognition. The ideas presented here are being implemented in a prototype system called Susie Software, which is embedded in the OWL system. OWL is currently under development in the Automatic Programming Group at the M.I.T. Laboratory for Computer Science. OWL is being used to explore the problems of constructing expert systems, and for Susie Software the domain of expertise is programming. In the Susie effort to date, major emphasis has been placed on the construction of a computational model for the structural aspects of English dialogue; it is this structural model that is discussed. GRA

N77-22883# Brown Univ., Providence, R. I. Lefschetz Center for Dynamical Systems.

GENERALIZED SOLUTIONS IN OPTIMAL STOCHASTIC CONTROL

Wendell H. Fleming Jun. 1976 26 p refs Presented at the 2nd Kingston Conf. on Differential Games and Control Theory, R. I., Jun. 1976

(Grants AF-AFOSR-2078-71; NSF GP-38428)

(AD-A033090; AFOSR-76-1249TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Generalized solutions in calculus of variations were introduced many years ago by L. C. Young. By doing so, he obtained solutions in some wider sense to problems which have no ordinary solution. Similar ideas reappeared in optimal control theory under such names as relaxed controls, chattering controls, or sliding regimes. Under appropriate assumptions, a relaxed optimal control was shown to exist. If, in addition, a Filippov-type convexity condition holds, the methods show that there is an optimal control in the ordinary sense. The author makes straightforward adaptation of the idea of relaxed control, to a class of problems which are stochastic perturbations of the standard Pontryagin control problem. He proves the existence of a relaxed optimal control. That result applies if the controller has complete information at each time t, and also if the control is open loop. GRA

N77-22884# Army Engineer Topographic Labs., Fort Belvoir, Va.

ERRORFREE COMPRESSION OF DIGITAL IMAGERY

Michael A. Crombie Nov. 1976 30 p refs

(AD-A033272; ETL-0079) Avail: NTIS HC A03/MF A01 CSCL 09/2

The notion of source entropy is used to place an upper bound on the redundancy in a digitized aerial image. Two image transformations, designed to reduce statistical dependence followed by Huffman coding of the transformed data, are compared to one another and to the source entropy. GRA

N77-22885# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

SIMULATION OF ADAPTIVE CONTROL BY INSTRUMENTAL-VARIABLE IDENTIFICATION Interim Report

A. T. Touchstone and A. B. Corripio 1976 6 p refs

(Grant AF-AFOSR-2580-74)

(AD-A033000; AFOSR-76-1177TR) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper presents the use of computer simulation to test the application of the instrumental-variable method of process identification to the adaptive temperature control of a chemical reactor. The method is shown to be stable when used in a closed-loop configuration to update the parameters of a discrete linear model of the reactor. The updated parameters are used to adjust the parameters of a feedback control algorithm. Dynamic information is generated by aperiodic changes in control set-point. Unmeasured disturbances are shown to deteriorate the parameter estimates, but without catastrophic effects. Author (GRA)

N77-22886# Southeastern Massachusetts Univ., North Dartmouth. Dept. of Electrical Engineering.

A NEW SOFTWARE PACKAGE FOR SEISMIC AND IMAGERY RECOGNITION

C. H. Chen 7 Sep. 1976 34 p ref

(Grant AF-AFOSR-2971-76)

(AD-A032739; EE-76-4; AFOSR-76-1166TR) Avail: NTIS HC A03/MF A01 CSCL 09/2

This report summarizes the software development effort on seismic and imagery pattern recognition studies under the support of the grant. The program libraries and major program listings are described in detail. The complete recognition system based on PDP 11-45 minicomputer and display units is truly interactive with the aid of the software package described. Furthermore, all algorithms of the programs listed have provided excellent recognition results. Author (GRA)

N77-22887# Pattern Analysis and Recognition Corp., Rome, N.Y.

PROTOTYPE PAGE READER DESIGN STUDY Final Technical Report, Jun. 1975 - Jun. 1976

Paul C. Kane, Edward G. Fisher, Frank H. Feng, George E. Forsen, and Earl W. Caldwell Griffiss AFB, N. Y. RADC Nov. 1976 136 p refs

(Contract F30602-75-C-0269)

(AD-A033537; PAR-76-22; RADC-TR-76-325) Avail: NTIS HC A07/MF A01 CSCL 09/2

The past fifteen years have produced significant achievements in the field of Optical Character Recognition (OCR). Today there exist a number of commercially-available OCR systems which are capable of reading a wide variety of type fonts, provided that the input is composed high quality material prepared in a cooperative environment. In terms of human recognition, the restrictions implied by the term high quality material must be considered severe. The machine reject rates on degraded material simply do not correspond to those of the human. To some degree, the performance differential between man and machine is attributable to the machine's incomplete use of available information. This report describes the results obtained on a research project to evaluate a recognition technique for typeset Latin (English) and Cyrillic (Russian) alphabetic characters which have been scanned and digitized at comparatively high spatial resolution and high grey-level quantization by the LIPS scanner. A normalized correlation technique was employed as the recognition algorithm, at the suggestion of the Government. This technique allows recognition in severe noise conditions such as might occur with poor quality printing. GRA

N77-22888# Massachusetts Univ., Amherst. Dept. of Electrical and Computer Engineering.

APPLICATIONS OF INFORMATION AND SYSTEM THEORY TO AIR FORCE PROBLEMS IN COMMUNICATIONS AND DATA HANDLING Interim Scientific Report, 1 Sep. 1975 - 31 Aug. 1976

J. K. Wolf 15 Oct. 1976 31 p refs

(Grant AF-AFOSR-2601-74)

(AD-A033377; AFOSR-76-1234TR) Avail: NTIS HC A03/MF A01 CSCL 09/4

This report summarizes the results of research performed under Grant AFOSR 74-2601 for the period 1 Sep 75 to 31 Aug 76. The research was concerned with problems in communications theory and information theory and their application. Specific problems considered were: (a) soft decision decoding of linear block codes, (b) application of coding to computers, and (c) coding for noisy channels including multi-user channels. Author (GRA)

N77-22889# Maryland Univ., College Park. Computer Science Center.

PIECEWISE APPROXIMATION OF PICTURES USING MAXIMAL NEIGHBORHOODS

Larry S. Davis, Azriel Rosenfeld, and Narenda Ahuja May 1976 30 p refs

(Contract F44620-72-C-0062; AF Proj. 9769)

(AD-A032746; AFOSR-76-1204TR) Avail: NTIS HC A02/MF A01 CSCL 17/8

Given a picture having approximately piecewise constant gray level, each point P has a largest neighborhood N(P) that is entirely contained in one of the constant regions, and the set of maximal N(P)s (i.e., N(P)s not contained in other N(P)s) constitutes an economical description of the picture, generalizing the Blum skeleton or medial axis transformation. The picture can be smoothed, without excessive blurring, by averaging over each N(P). By taking differences between pairs of touching maximal N(P)s, the edges between the regions can be detected; since this edge detection scheme is not based on symmetrical detection operators, it is not handicapped when two adjacent regions differ greatly in size. Author (GRA)

N77-22890# Brown Univ., Providence, R. I. Div. of Engineering.

ON THE BILINEAR REGULATOR PROBLEM WITH A PURSUIT-EVASION APPLICATION Interim Report

Kuang-Chung Wei and Allan E. Pearson 9 Jun. 1976 36 p refs

(Grant AF-AFOSR-2793-75)

(AD-A032876; AFOSR-76-1149TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

The purpose of this work is to formulate and analyze the quadratic cost problem associated with a bilinear system. The existence of optimal controls to this problem is established. A class of commutative bilinear systems and the minimum energy problem associated with it are investigated. It is shown that optimal controls for this problem are in constant form which is determined by the boundary conditions. Sufficient conditions for uniqueness of optimal controls are also derived for this problem. This system is shown to be reachable to a given state by a constant input if and only if it is reachable to by a time-varying input. This gives the control engineer a great deal of flexibility in the design of a feasible easily-implemented controller. Application to a two-dimensional pursuit-evasion problem is considered in which the minimum energy problem with terminal constraint is solved analytically. Author (GRA)

N77-22891# Northwestern Univ., Evanston, Ill. Dept. of Mechanical Engineering.
OPTIMAL CONTROL OF SYSTEMS WITH UNCERTAINTY Interim Report, 1 Sep. 1975 - 31 Aug. 1976
W. E. Schmitendorf 31 Aug. 1976 9 p refs
(Grant AF-AFOSR-2923-76; AF Proj. 9769)
(AD-A032846; AFOSR-76-1167TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

This investigation of static minmax problems has produced necessary and sufficient conditions which can be used to solve such problems. This has also led to a clearer understanding of the nature of minmax problems for dynamic problems with uncertainty in the state equations or in the initial conditions, sufficient conditions were derived which the minmax control must satisfy and, using these conditions, constructive techniques were developed which can be used to generate minmax solutions. These methods are now available for solving minmax problems and can be used to analyze problems where there is uncertainty in the model or in the measurement of the initial state. These methods will aid in the design of systems where exact models of the systems are not available or where exact measurements of the state of the system cannot be obtained. Author (GRA)

N77-22892# Rice Univ., Houston, Tex. Dept. of Electrical Engineering.
SOME DISTANCE MEASURES AND THEIR USE IN FEATURE SELECTION Interim Report
P. Papantoni-Kazakos 1976 38 p refs
(Grant AF-AFOSR-3156-77; AF Proj. 2304)
(AD-A033316; AFOSR-76-1231TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

Five different distance measures are compared, evaluated, and used for data reduction in two separate Gaussian families. Author (GRA)

N77-22812*# Lund Univ. (Sweden).
SELF-TUNING REGULATORS
K. J. Astrom *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 51-68 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22814*# Purdue Univ., Lafayette, Ind.
FACTS AND FICTION OF LEARNING SYSTEMS
George N. Saridis *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 79-104 refs (For primary document see N77-22808 13-59)
(Grant NSF GK-36607)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22815*# Stanford Univ., Calif.
STATUS OF DUAL CONTROL THEORY
Edison Tse *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 105-121 refs (For primary document see N77-22808 13-59)
(Contract N00014-75-C-0738)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22816*# Massachusetts Inst. of Tech., Cambridge.
CLOSED-LOOP STRUCTURAL STABILITY FOR LINEAR-QUADRATIC OPTIMAL SYSTEMS
Poh Kam Wong and Michael Athans *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 123-140 refs (For primary document see N77-22808 13-59)
(Grants NGL-22-009-124; AF-AFOSR-72-2273)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22818*# Toronto Univ. (Ontario).
RECENT PROGRESS IN MULTIVARIABLE CONTROL
W. M. Wonham *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 157-164 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22819*# Washington Univ., St. Louis, Mo.
A SUMMARY OF NONLINEAR FILTERING
Ian B. Rhodes *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 165-179 refs (For primary document see N77-22808 13-59)
Avail: NTIS HC A10/MF A01 CSCL 12B

N77-22820*# Massachusetts Inst. of Tech., Cambridge.
A SURVEY OF DESIGN METHODS FOR FAILURE DETECTION IN DYNAMIC SYSTEMS
Alan S. Willsky *In* NASA. Ames Res. Center Systems Reliability Issues for Future Aircraft 1975 p 181-207 refs (For primary document see N77-22808 13-59)
(Grant NGL-22-009-124; NsG-1112)
Avail: NTIS HC A10/MF A01 CSCL 12B

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N77-22893 Massachusetts Univ., Amherst.
A PRIORI ESTIMATES FOR A CLASS OF NONLINEAR PROBLEMS AND APPLICATIONS Ph.D. Thesis
Mark Harris 1976 76 p
Avail: Univ. Microfilms Order No. 77-6456

A class of boundary value problems is studied for certain types of nonlinear elliptic systems of partial differential equations, motivated by some problems in elasticity. The main technical effort is concerned with obtaining a priori estimates for solutions of these problems in a Hilbert space setting. The estimates obtained are applied to questions of existence and multiplicity of solutions. The estimates to be derived fall into two categories: constructive bounds, which are computed in terms of the given data, and nonconstructive bounds, which are shown to exist but are not explicitly found. Bounds of either type are frequency useful in fixed point or topological degree arguments, while the constructive bounds may in addition have value for numerical applications. Dissert. Abstr.

N77-22894# Sandia Labs., Albuquerque, N.Mex. Numerical Mathematics Div.
SOLVING ORDINARY DIFFERENTIAL EQUATIONS FOR SIMULATION
L. F. Shampine Nov. 1976 10 p refs
(Contract E(29-1)-789)
(SAND-76-0636) Avail: NTIS HC A02/MF A01

Criteria for choosing a method for the numerical solution of ordinary differential equations for simulation problems are outlined. Then two kinds of Runge-Kutta formulas which are particularly efficient at doing those things expected at Runge-Kutta formulas are presented. These formulas perform better than the Adams methods. Pairs of third- and fourth-order Runge-Kutta formulas are discussed. ERA

N77-22895# California Univ., Livermore. Lawrence Livermore Lab.
DEC/SOL: SOLUTION OF DENSE SYSTEMS OF LINEAR ALGEBRAIC EQUATIONS
A. C. Hindmarsh, L. J. Sloan, K. W. Fong (Los Alamos Scientific Lab., N. Mex.), and G. H. Rodrigue 24 Jun. 1976 31 p refs
(Contract W-7405-eng-48)
(UCID-30137) Avail: NTIS HC A03/MF A01

Four versions of a pair of subroutines for solving N x N

systems of linear algebraic equations are described. In each case, the first routine, DEC, performs an LU decomposition of the matrix with partial pivoting, and the second, SOL, computes the solution vector by back-substitution. The first version is in FORTRAN 4, and is derived from routines DECOMP and SOLVE written by C. B. Moler. The second is a version for the CDC 7600 computer using STACKLIB. The third is a hand-coded (Compass) version for the 7600. The fourth is a vectorized version for the CDC STAR. Comparative tests on these routines are also described. ERA

N77-22896# California Univ., Livermore. Lawrence Livermore Lab.

PROGRAMS NAES AND SS: USER-ORIENTED PROGRAMS FOR SOLVING NONLINEAR ALGEBRAIC EQUATIONS AND ORDINARY DIFFERENTIAL EQUATIONS

Howard K. McCue 11 Aug. 1976 89 p
(Contract W-7405-eng-48)
(UCID-17267) Avail: NTIS HC A05/MF A01

Program NAES (Nonlinear Algebraic Equation Solver) is a FORTRAN 4 program used to solve the vector equation $f(x)=0$ for x. Two areas where Program NAES has proved to be useful are the solution for initial conditions and/or set points of complex systems of differential equations and the identification of system parameters from steady-state equations and steady-state data. Program SS (State Space) is a Fortran IV program used to solve a system of first-order, ordinary differential equations with a minimum of specialized coding. Program SS automatically provides a tabular listing and line-printer plots of the outputs. In addition, provisions are made to perform one-time preintegration calculations, read specialized input data, establish specialized output labels, make x-y plots of output variables, and record the minima/maxima of specified variables. Subroutines were written to provide delay, level detection with hysteresis, and solutions to implicit equations. ERA

N77-22897# Stanford Linear Accelerator Center, Calif.

NUMERICAL METHODS FOR NONLINEARLY CONSTRAINED OPTIMIZATION Ph.D. Thesis - Stanford Univ.

M. A. H. Wright Mar. 1976 262 p refs
(Contracts E(04-3)-0515; AT(04-3)-326-PA30; Grants NSF DCR-71-01996-A04-05; NSF DCR-72-03712)
(SLAC-193) Avail: NTIS HC A12/MF A01

A description of a feasible-point algorithm for nonlinearly constrained optimization is presented. The method is based on the properties of the trajectory of minima obtained by varying the barrier parameter of the logarithmic barrier function. The algorithm is closely related to a nonfeasible point method based on the trajectory of the quadratic penalty function, and this method is also described. The search direction in the trajectory algorithms is determined by solving a quadratic programming subproblem whose objective function is based on an approximation to the Lagrangian function. This subproblem is well posed whatever the value of the penalty or barrier parameter, unlike the determination of the search direction for penalty and barrier function methods. The step taken along the search direction is obtained by considering an appropriate reduction in the respective penalty or barrier function. ERA

N77-22898# Sandia Labs., Albuquerque, N.Mex. Advanced Mechanical Div.

APPROXIMATION TECHNIQUE FOR FUNCTIONS OF SEVERAL VARIABLES

R. E. Humphrey Aug. 1976 23 p refs Sponsored by ERDA
(SAND-76-8038) Avail: NTIS HC A02/MF A01

A numerical technique is described for constructing a function of several variables which best approximates a set of empirical data. The technique preserves the local characteristics of the data and provides a means for interpolation and extrapolation of the data which does not require the data points to be located over an orderly structured grid of values. A digital computer program which performs the required numerical computations is included. ERA

N77-22899# Sandia Labs., Albuquerque, N.Mex. Computational Physics and Mechanics Div.

TWO-DIMENSIONAL VISCOELASTIC MODEL FOR USE IN FINITE DIFFERENCE CALCULATIONS

J. W. Swegle Oct. 1976 35 p refs
(Contract E(29-1)-789)
(SAND-76-0527) Avail: NTIS HC A03/MF A01

A general phenomenological model is developed to describe rate-dependent behavior in multidimensional strain. It is applied to the specific problem of two dimensional viscoelasticity. Results are compared to one dimensional calculations and to two dimensional experiments. Calculations are also done for the problems of applied pressures at the surfaces of cylindrical and spherical cavities in viscoelastic media. ERA

N77-22900# California Univ., Los Angeles. Dept. of Mathematics.

ON A BOUNDARY EXTRAPOLATION THEOREM BY KREISS Interim Report

Moshe Goldberg Sep. 1976 18 p refs
(Grant AF-AFOSR-3046-76; AF Proj. 9749)
(AD-A032926; AFOSR-76-1182TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

A hardly known and very important result of Kreiss is proven explicitly: outflow boundary extrapolation which complements stable dissipative schemes for linear hyperbolic initial value problems, maintains stability. In view of this result, the Lax-Wendroff and the Gottlieb-Turkel schemes are applied to a test problem; as expected from the rate-of-convergence theory by Gustafsson, global order to accuracy is preserved if outflow boundary computations employ extrapolation of (local) accuracy of the same order. Author (GRA)

N77-22901# Louisiana State Univ., Baton Rouge. Dept. of Chemical Engineering.

PROCESS IDENTIFICATION UTILIZING A SEQUENTIAL INSTRUMENTAL VARIABLE REGRESSION ALGORITHM Interim Report

A. T. Touchstone and A. B. Corripio 1976 11 p refs
(Grant AF-AFOSR-2580-74; AF Proj. 9769)
(AD-A032847; AFOSR-76-1171TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Instrumental variable (IV) regression is applied to the estimation of the parameters of a difference equation model of a process subject to noise. The technique preserves the simplicity of least-squares estimation, and is shown to significantly reduce the bias on the parameter estimates caused by measurement noise. A second-order example is used to illustrate the performance of the IV estimator, and to study the selection of sample time and initialization parameters. Demonstration is given on the parameter tracking capability of the dynamic form of the algorithm. The dynamic algorithm is important for use in adaptive control. Author (GRA)

N77-22902# Maryland Univ., College Park. Dept. of Computer Science.

SPONTANEOUS COMPUTATION IN COGNITIVE MODELS

Chuck Rieger Jul. 1976 115 p refs
(Contract N00014-76-C-0477)
(AD-A032812; TR-459) Avail: NTIS HC A06/MF A01 CSCL 12/1

The engineering and theory of a style of computation in which code runs spontaneously (as opposed to on demand) are developed. The notion of a spontaneous computation (SC) is defined, briefly surveyed, and compared to other styles of computation. Then, in the first half of the paper, a LISP-based system which carries out a general theory of SC is described. This includes: complex trigger patterns, organization of SC trigger patterns into associative trigger trees,' and the structure of an SC itself. Higher level organization and control of SC are then discussed, introducing the notion of a 'channel.' In the second half of the paper, some theoretical ideas about how to use SC in cognitive models, particularly those modeling language comprehension and problem solving, are presented and discussed. The discussion includes: SC as a model of non-algorithmic inference, SCs as 'character followers' in a story comprehension system, SCs as subgoal protectors and plan optimizers in a problem solver, and the relationships among SC, context, and frames. In particular, ideas related to partially triggered SCs, and their theoretical applications as context-focusers and motivation-generators are explored. The paper represents one aspect of a larger project called the Commonsense Algorithm Project, and

includes as appendices a self-contained system of LISP code which implements many of the ideas discussed in the text. (GRA)

N77-22903*# Mississippi State Univ., Mississippi State. Engineering Industrial Research Station.
MACHINE SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS IN THE NUMERICALLY GENERATED COORDINATE SYSTEMS Interim Report
Z. U. A. Warsi and J. F. Thompson, Jr. Aug. 1976 37 p refs
(Grants NsG-1242; NGR-25-001-055; AF-AFOSR-2922-76)
(NASA-CR-152831; AD-A033318; MSSU-EIRS-ASE-77-1; AASE-76-153; AFOSR-76-1241TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper presents an in depth study on the numerically generated body-fitted coordinate systems. All fundamental ideas have been developed from a very basic point of view which leads to a well structured method of coordinate system control in any region of interest. It is also shown how the developed concepts are instrumental in obtaining the machine solutions of the field differential equations in general dependent variables on the generated coordinate systems. Author (GRA)

N77-22904# Brown Univ., Providence, R. I. Div. of Engineering.
A NOTE ON THE ALGEBRAIC MATRIX RICATI EQUATION Interim Report
A. E. Pearson and W. H. Kwon 1976 8 p refs
(Grant AF-AFOSR-2793-75)
(AD-A032681; AFOSR-76-1154TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The results for the matrix Lyapunov equation are extended to the case of an algebraic matrix Riccati equation. Some errors are pointed out by a counter example. The estimations obtained in this note are shown to be exact for certain cases. Similar results are possible for the discrete algebraic matrix Riccati equation. Author (GRA)

N77-22905# Michigan Univ., Ann Arbor. Dept. of Electrical and Computer Engineering.
COMPLEXITY OF VECTORIZED SOLUTION OF TWO-DIMENSIONAL FINITE ELEMENT GRIDS Interim Report
D. A. Calahan 1976 14 p refs
(Grant AF-AFOSR-2812-75; AF Proj. 9749)
(AD-A032689; AFOSR-76-0871TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The dissected direct solution of finite element grids has been shown to be more efficient than band-related methods. In this paper it is shown that vector processors can be used to solve such grids despite their apparent disassociated structure. Operation counts and vector counts are given as a function of grid size and order of rectangular element. Author (GRA)

N77-22906# North Carolina State Univ., Raleigh.
RESEARCH ON NONLINEAR DIFFERENTIAL EQUATIONS Final Report, 1 Jun. 1974 - 31 Aug. 1976
Robert H. Martin, Jr. 26 Oct. 1976 13 p refs
(Grants DAHC04-74-G-0213; DAHC04-75-G-0145)
(AD-A033595; ARO-12037.4-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

The research described in this report deals with the existence and behavior of solutions to nonlinear differential equations in a Banach space. This includes the determination of invariant sets for solutions, relations involving inequalities between solutions, and global existence and asymptotic properties (stability) of solutions. The abstract techniques and results developed of differential equations in Banach spaces are applied to semilinear parabolic systems. These examples indicate that several classical as well as new results in the study of solutions to semilinear partial differential equations may be obtained by abstract techniques. Author (GRA)

N77-22907# Naval Academy, Annapolis, Md.
MATHEMATICAL-STATISTICAL AND DIGITAL COMPUTER ANALYSIS OF TIME SERIES DATA
Steven J. Raher 17 May 1976 165 p refs
(AD-A032719; USNA-TSPR-81) Avail: NTIS HC A08/MF A01 CSCL 09/3

The purpose of this study is to develop a series of computer programs for use in analyzing time series data (waves) - such as EEG readings. Programs were used to produce reliable estimates of correlations, spectra, cross spectra, and partial coherences of multi-channel random processes. The software package was written to be easily adaptable to different sampling rates, amounts of data, and numbers of channels. Provisions for digital prefiltering of data, detrending, and smoothing (using a number of lag windows) were also included. Techniques for estimation of spectra by fitting single- and multi-channel autoregressive schemes to sampled data were also applied and found to yield results consistent with the other methods. Author (GRA)

N77-22908# DRC Inventory Research Office, Philadelphia, Pa.
KALMAN AND MOVING AVERAGE FILTERS FOR FORECASTING: SYSTEMATICS OF DEMAND PROCESSES AND EXTENSIONS
Donald A. Orr Oct. 1976 64 p refs
(AD-A032496; IRO-TR-2-77) Avail: NTIS HC A04/MF A01 CSCL 12/1

This technical report is a digest of theoretical (mostly) results on short term forecasting. The ubiquitous criterion is mean square error MSE, which is the most amenable to mathematical analysis, but in some transformations of process variables to be forecasted infer other error measures. This study is also a proselytization for the Kalman filter, which together with its underlying vector process model, is a powerful and flexible algorithm which encompasses many other techniques. To an extent, the study concerns systematics, a scheme for classifying such well known forecasting algorithms as exponential smoothing, moving averages, regression line fitting, by the underlying processes for which these algorithms are optimal or sub-optimal. GRA

N77-22909# Harry Diamond Labs., Adelphi, Md.
EXACT EVALUATION OF THE KONDO INTEGRAL
John L. Scales, Vick Karayianis, and Clyde A. Morrison Oct. 1976 21 p refs
(DA Proj. 1T1-61102-AH-46)
(AD-A033119; HDL-TR-1771) Avail: NTIS HC A02/MF A01 CSCL 12/1

A procedure is given for obtaining an exact evaluation of the Kondo integral. This is a mathematical function used to characterize a type of electron scattering; it arises in connection with a variety of physical processes. Previously, there was no exact evaluation of the integral, and various approximation functions were used to represent it. Two of these approximations are compared with the exact answer. Author (GRA)

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N77-22910 Princeton Univ., N.J.
THE COMPLEXITY OF COMBINATORIAL OPTIMIZATION PROBLEMS Ph.D. Thesis
Christos Harilaos Papadimitriou 1976 139 p
Avail: Univ. Microfilms Order No. 77-4795

The Euclidean version of the Traveling Saleman Problem (TSP) is NP-Complete. A framework for the study of the performance of local search algorithms is developed and shows that unless P = NP, any local search algorithm for the TSP, having polynomial time complexity per iteration, must produce arbitrarily bad local optima. The complexity of the local structure of certain convex polytopes associated with such problems is discussed. It is shown that characterizing, even locally, the structure of the TSP polytope is an NP-Hard task and several implications of this fact are discussed. The complexity of certain combinatorial optimization problems related to optimal traversals of the graphs are studied. It is found that these problems appear to be considerably harder on mixed graphs than on totally directed and totally undirected graphs. Dissert. Abstr.

N77-22911# Cornell Univ., Ithaca, N.Y. School of Operations Research and Industrial Engineering.
MULTIPLE-DECISION SELECTION AND RANKING PRO-

CEDURES Final Report, 1 Jul. 1973 - 30 Sep. 1976
Robert E. Bechhofer 12 Nov. 1976 12 p refs
(Contract DAAG29-73-C-0008)
(AD-A033478; ARO-11077.16-M) Avail: NTIS HC A02/MF A01 CSCL 12/1

The report lists the technical reports and published papers (and those accepted for or submitted for publication) which were written with the full or partial support of the contract. Also included is a list of the scientific personnel supported by the contract, and the advanced degrees earned by them while supported by the contract. Some general comments are made concerning research progress and implementation of findings.
Author (GRA)

N77-22912# Hanford Engineering Development Lab., Richland, Wash.
MODIFIED MONTE CARLO PROGRAM FOR SAND-II WITH SOLUTION WEIGHTING AND ERROR ANALYSIS
C. A. Oster (Battelle-Northwest), W. N. McElroy, R. L. Simons, E. P. Lippincott, and G. R. Odette (California Univ., Santa Barbara) Aug. 1976 192 p refs
(Contract E(45-1)-2170)
(HEDL-TME-76-60) Avail: NTIS HC A09/MF A01

In previous versions of the SAND-II and Monte Carlo codes, uncertainty data for both measured activities and cross sections were used only in a statistical sense for error propagation studies. These versions used an equal uncertainty procedure for weighting each foil. An in-depth study is presented of different weighting procedures utilizing available uncertaintly data to obtain a most appropriate SAND-II solution flux spectrum. An improved and modified SAND-II Monte Carlo code was developed based on extensive computer runs involving data from 21 foils irradiated in CFRMF as a part of the Interlaboratory LMFBR Reaction Rate (ILRR) program. ERA

N77-22913# Los Alamos Scientific Lab., N. Mex.
REPORT ON THE APPLICATION OF STATISTICAL TECHNIQUES TO THE ANALYSIS OF COMPUTER CODES
Michael D. McKay and W. J. Conover (Texas Tech. Univ.) Jul. 1976 15 p refs
(Contract W-7405-eng-36)
(LA-6479-MS) Avail: NTIS HC A02/MF A01

Two types of sampling plans are presented as alternatives to simple random sampling in Monte Carlo studies. These plans are shown to be improvements over simple random sampling with respect to the variance of a class of estimators which includes the sample mean and the sample cumulative distribution function. The partial rank correlation coefficient is presented as a measure of sensitivity. Examples and test cases are included.
ERA

N77-22914# Purdue Univ., Lafayette, Ind. Dept. of Statistics.
SUBSET SELECTION PROCEDURES FOR THE MEANS OF NORMAL POPULATIONS WITH UNEQUAL VARIANCES: UNEQUAL SAMPLE SIZES CASE
Shanti S. Gupta and Wing-Yue Wong Oct. 1976 31 p refs
(Contract N00014-75-C-0455)
(AD-A033338; Mimeo-Ser-473) Avail: NTIS HC A03/MF A01 CSCL 12/2

This paper deals with some subset selection procedures for the largest unknown means of k normal populations with unequal variances. The procedures are based on unequal numbers of observations from the given k normal populations. Some properties of the proposed selection rules are investigated. The problem of selecting all the normal populations with means better than a standard or control is also considered. Again, the proposed procedures are based on unequal number of observations from each of the populations. An application to testing the equality of k normal means with unequal variances, as in Behrens-Fisher problem, is described. Author (GRA)

N77-22915# California Univ., Los Angeles. Dept. of System Sciences.
STOCHASTIC FILTERING AND CONTROL OF LINEAR SYSTEMS: A GENERAL THEORY Interim Report
A. V. Balakrishnan 17 Aug. 1976 20 p refs
(Grant AF-AFOSR-2492-73; AF Proj. 9769)
(AD-A032906; AFOSR-76-1142TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper describes a general theory of filtering and control problems for linear systems, arising in particular from distributed parameter systems. Author (GRA)

N77-22916# Illinois Univ., Chicago. Dept. of Mathematics.
INFINITELY DIVISIBLE DISTRIBUTIONS IN STATISTICAL INFERENCE: HEAVY-TAILED DISTRIBUTIONS AND CONVOLUTION MODELS
Stanley L. Sclove 1 Nov. 1976 13 p refs
(Grant AF-AFOSR-3050-76)
(AD-A033385; AFOSR-76-1258TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

The family of infinitely divisible distributions is shown to provide alternative formulations in several inferential situations. In particular, the family provides heavy-tailed distributions and distributions for use in models involving convolutions, such as signal-plus-noise models. Characterizations of sub-families of the infinitely divisible family are used to obtain statistical tests of membership in those sub-families. Special attention is given to the normal and normal-plus-Poisson sub-families. Author (GRA)

N77-22917# Illinois Univ., Chicago. Dept. of Mathematics.
EXAMINATION AND ANALYSIS OF RESIDUALS: A TEST FOR DETECTING A MONOTONIC RELATION BETWEEN MEAN AND VARIANCE IN REGRESSION THROUGH THE ORIGIN Interim Report
A. Hedayat, B. L. Raktoe (Guelph Univ., Ontario), and Prem P. Talwar (Guelph Univ., Ontario) 9 Nov. 1976 15 p refs
(Grant AF-AFOSR-3050-76)
(AD-A033602; AFOSR-76-1256TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

This paper presents a simple and exact test for detecting a monotonic relation between the mean and variance in linear regression through the origin. This test resulted from utilizing uncorrelated Theil-residuals and the Goldfeld-Quandt peak test. A numerical example is provided to elucidate the method. A simulation experiment was performed to compare the empirical power of this test with those of the existing tests. GRA

N77-22918# Maryland Univ. Baltimore County, Baltimore. Div. of Mathematics and Physics.
EXPONENTIAL FOURIER DENSITIES ON SO(3) AND OPTIMAL ESTIMATION AND DETECTION FOR ROTATIONAL PROCESSES
James Ting-Ho Lo and Linda R. Eshleman Jul. 1976 34 p refs
(Grant AF-AFOSR-2671-74; AF Proj. 9769)
(AD-A032852; MRR-76-9; AFOSR-74-2671TR) Avail: NTIS HC A03/MF A01 CSCL 12/1

This paper presents a new representation of a probability density function on the three dimensional rotation group, SO(3), which generalizes the exponential Fourier densities on the circle. As in the circle case, this class of densities on SO(3) is also closed under the operation of taking conditional distributions. Several simple multistage estimation and detection models are considered in this paper. The closure property will determine the sequential conditional densities by recursively updating a finite and fixed number of coefficients. An error criterion, which is compatible with a Riemannian metric, will be introduced and discussed. The optimal orientation estimates, with respect to this error criterion, will be derived for a given probability distribution, illustrating how the updated conditional densities can be used to sequentially determine the optimal estimates on SO(3). GRA

N77-22919# Southeastern Massachusetts Univ., North Dartmouth. Dept. of Electrical Engineering.
PERFORMANCE BOUNDS OF A CLASS OF SAMPLE-BASED CLASSIFICATION PROCEDURES
C. H. Chen 21 Sep. 1976 14 p refs
(Grant AF-AFOSR-2951-76)
(AD-A032748; EE-76-6; AFOSR-76-1199TR) Avail: NTIS HC A02/MF A01 CSCL 12/1

Performance bounds of a class of sample-based classification procedures using the K-nearest-neighbor rule (k-NNR) are considered in this paper. By using K-NNR for decision, it is that

the lower bounds of the probability of correct decision are very close to that obtained with the Bayes linear discriminant analysis based on the assumption of two multivariate Gaussian densities with different mean vectors but equal covariance matrices. This surprisingly good result suggests that the nonparametric method is very effective at small sample size situation which is of much practical signficance. By using the k-NNR for density estimates, an upper bound of the probability of correct decision provides an optimistic estimate of the performance which again indicated the effectiveness of the nonparametric technique. Author (GRA)

N77-22920# Syracuse Univ., N.Y. Dept. of Industrial Engineering and Operations Research.

SEMI-STATIONARY CLEARING PROCESSES Interim Report

Richard F. Serfozo and Shaler Stidham (North Carolina State Univ., Raleigh) Aug. 1976 25 p refs

(Grants AF-AFOSR-2627-74; NSF ENG-13653; NSF GI-37472)

(AD-A032877; AFOSR-76-1196TR; NCSU-IE-TR-76-9) Avail: NTIS HC A02/MF A01 CSCL 12/2

A clearing process describes the net quantity in a service system (e.g. a batch service queue or dam) which receives an exogenous random input over time, and has an output mechanism that intermittently clears random quantities from the system. A semi-stationary clearing process is strictly stationary over its random clearing epochs. The asymptotic distributions of such processes are described, and how they arise in limits of certain functionals of these processes is shown. Identified are some clearing processes with uniform asymptotic distributions. This is true for modulo c clearing with a stationary input if the Palm probability is used rather than the usual probability. Also, a functional central limit law and law of the interated logorithm for clearing processes, as well as a result on the convergence of a sequence of such processes is presented. Author (GRA)

N77-22921# Stanford Univ., Calif. Dept. of Operations Research.

SOME EXTENSIONS OF MARKOV REPAIR MODELS

Yukio Hatoyama 6 Aug. 1976 83 p refs

(Contract N00014-75-C-0561; NR Proj. 042-002)

(AD-A033342; SU-TR-176) Avail: NTIS HC A05/MF A01 CSCL 12/2

In this paper, two different kinds of discrete time maintenance models with repair shops are studied. The first type of model has a multiple number of repair shops in the system. When information on the type of repair required is available at the moment of each decision, simple optimal maintenance policies are obtained under the mild conditions. On the other hand, very restrictive conditions are required for the case when such information is not available. In the next model considered, the action space is expanded to include the option of opening or closing the repair service gate, as well as the option of repairing or leaving an operating machine alone. A two-dimensional control limit policy is defined, and the optimality of such a control limit policy is assured when the repair time of a machine is negligibly small, a very reasonable condition. When the repair time is not negligible, but has a geometric distribution, a restrictive condition on the holding costs must be satisfied. (GRA)

N77-22922# Stanford Univ., Calif. Dept. of Operations Research.

ESTIMATING THE TRUE PROBABILITY OF CORRECT SELECTION FOR LOCATION AND SCALE PARAMETER FAMILIES

I. Olkin, M. Sobel, and Y. L. Tong 28 Jun. 1976 21 p refs Prepared in cooperation with Calif. Univ., Santa Barbara and Nebr. Univ., Lincoln

(Contract N00014-75-C-0561; Grant NSF MPS-75-09450)

(AD-A033341; SU-TR-174) Avail: NTIS HC A02/MF A01 CSCL 12/2

The usual formulation of the problem of selecting the best of k populations has been studied from the point of view of designing an experiment that will guarantee a certain probability of making a correct selection (PCS). However, in retrospective studies the sample has already been taken and we wish to estimate the probability of making a correct selection using this data. The present study deals with obtaining a class of upper and lower bounds for the true PCS and its estimator using the methods of majorization. We also study the large sample behavior of the estimator of the PCS, which turns out to be asymptotically normal. Author (GRA)

N77-22923# Kansas State Univ., Manhattan.

ESTIMATING VARIANCE IN THE PRESENCE OF OUTLIERS Final Report, 1 Jun. 1975 - 31 Aug. 1976

Dallas E. Johnson 1976 29 p refs

(Grant DAHC04-75-G-0168)

(AD-A033598; ARO-13372.1-M) Avail: NTIS HC A03/MF A01 CSCL 12/1

New estimators for variance have been proposed and some of their properties have been examined. The estimators are quite simple to calculate and give a good range in which the variance will probably fall. However, tables for the divisors have not yet been generated for any cases other than when the sample size is 10. GRA

N77-22924# North Carolina Univ., Chapel Hill. Dept. of Statistics.

STOCHASTIC AND MULTIPLE WIENER INTEGRALS FOR GAUSSIAN PROCESSES

Steel T. Huang (Cincinnati Univ., Ohio) and Stamatis Cambanis Aug. 1976 71 p refs

(Grant AF-AFOSR-2796-75)

(AD-A033249; AFOSR-76-1180TR; Mimeo-Ser-1087) Avail: NTIS HC A04/MF A01 CSCL 12/1

Mulitple Wiener integrals and stochastic integrals are defined for Gaussian processes, extending the related notions for the Wiener process. It is shown that every L2-functional of a Gaussian process admits an adapted stochastic integral representation and an orthogonal series expansion in terms of multiple Wiener integrals. Also some results of Wiener's theory of nonlinear noise are generalized to noises other than white. Author (GRA)

N77-22925# North Carolina Univ., Chapel Hill. Dept. of Statistics.

SOME NEW RESULTS IN THE THEORY OF RECURRENT EVENTS: A PRELIMINARY REPORT

Walter L. Smith Nov. 1976 91 p refs

(Contract N00014-76-C-0550)

(AD-A032695; Mimeo-Ser-1091) Avail: NTIS HC A05/MF A01 CSCL 12/1

The main focus of the work is to obtain approximate formulae for u sub n, the expected number of occurrences of an aperiodic recurrent event at time n. The formulae are all of the type u sub n = psi sub n + rho sub n, where psi sub n is explicitly calculable in terms of known features of the model and rho sub n is a remainder term tending to zero as n approaches the limit of infinity. The thrust of the work lies in showing the way in which assumptions about the underlying model are reflected by rho sub n. GRA

N77-22926# North Carolina Univ., Chapel Hill. Dept. of Statistics.

LOCAL TIMES FOR VECTOR FUNCTIONS: ENERGY INTEGRALS AND LOCAL GROWTH RATES

Donald Geman Sep. 1976 19 p refs Sponsored in part by NSF

(Contract N00014-75-C-0809)

(AD-A033076; Mimeo-Ser-1088) Avail: NTIS HC A02/MF A01 CSCL 12/1

By and large, the study of local times has been confined to probabilistic settings, either as in Markov processes where the potential theoretic and stochastic analysis are fused, or where real variable results may be separately developed, but with an eye toward applications, especially to sample function analysis. Here non-random functions are exclusively dealt with. More specifically, it is intended to further develop the observation of S. M. Berman that, loosely, the more regular the local time, the more irregular the function, by amplifying several earlier results of ours and J. Horowitz, such as: if a function has a local time, any approximate local modulus grows at least linearly, and grows faster than linearly if the local time is continuous in its time parameter. GRA

N77-22927# North Carolina Univ., Chapel Hill. Dept. of Statistics.
EXTREMES OF MOVING AVERAGES OF STABLE PROCESSES
Holger Rootzen Oct. 1976 41 p refs
(Contract N00014-75-C-0809)
(AD-A032696; Mimeo-Ser-1089) Avail: NTIS HC A03/MF A01 CSCL 12/1

In this paper extremes of non-normal stable moving average processes are studied. The extremes are described as a marked point process, consisting of the point process of (separated) exceedances of a level together with marks associated with the points, a mark being the normalized sample path of X(t) around an exceedance. It is proved that this marked point process converges in distribution as the level increases to infinity. The limiting distribution is that of a Poisson process with independent marks which have random heights but otherwise are deterministic. As a byproduct of the proof for the continuous-time case, a result on sample path continuity of stable processes is obtained. GRA

N77-22928# Texas Univ., Austin. Dept. of Electrical Engineering.
NONPARAMETRIC DISCRIMINATION AND DENSITY ESTIMATION Ph.D. Thesis. Interim Report
Luc P. J. A. Devroye Dec. 1976 165 p refs
(Grant AF-AFOSR-2371-72)
(AD-A032738; AFOSR-76-1208TR) Avail: NTIS HC A08/MF A01 CSCL 12/1

The asymptotic properties of generalized nearest neighbor rules and other nonparametric discrimination rules are investigated. The problem is to estimate an M-ary valued parameter theta if an observed random vector X and data consisting of a sequence of independent random vectors (X sub 1, theta sub 1) (X sub n, theta sub n) with the same distribution as (X, theta) are given. Conditions are given under which the rules are asymptotically optimal. Consistent density estimates can be used to construct asymptotically optimal rules if the distribution function of X is absolutely continuous. A detailed study is made of the pointwise, integral and uniform convergence of the Parzen-Rosenblatt and Loftsgaarden-Quesenberry density estimates. In addition, methods of estimating the conditional probability of error with a particular data set are given. For linear discrimination rules, local rules and two-step rules, estimates are found whose performance is bounded independently of the distribution of (X theta). (GRA)

N77-22929# Notre Dame Univ., Ind. Dept. of Aerospace and Mechanical Engineering.
IMPROVED TECHNIQUES FOR SIMULATION EXPERIMENTATION WITH MULTIPLE-RESPONSE STOCHASTIC PROCESSES Final Report
William E. Biles 9 Dec. 1976 66 p refs
(Grant NSF ENG-74-19313-A01)
(PB-262038/3) Avail: NTIS HC A04/MF A01 CSCL 09B

Two formulations of the multiple response simulation problem are examined: (1) constrained optimization; and (2) multiple objective optimization. Three classes of optimization methods are examined: (1) direct search methods, including random search, pattern search, sequential simplex search, and complex search; (2) first-order response surface methods; and (3) second-order response surface methods. For each of these optimization methods, the effects of such factors as point spacing, replication, and the level of random error are assessed, using four test problems with known solutions. Results reveal several effective and efficient optimization methods for application to multiple response simulation. GRA

N77-22930# Stanford Univ., Calif. Dept. of Statistics.
MULTIVARIATE STATISTICAL ANALYSIS AS APPLIED TO THE PROBLEMS OF UNCOVERING VOLCANIC STRUCTURES AND THE EVOLUTION OF RIFT-ZONE VOLCANISM
Edward I. Bloomstein 6 Oct. 1976 38 p refs
(Contract N00014-76-C-0475; Grant NSF MPS-75-09450; NR Proj. 042-267)
(AD-A033268; SU-TR-239; SU-TR-117) Avail: NTIS HC A03/MF A01 CSCL 08/7

Part 1 - Multivariate Statistical Analysis as Applied to the Problem of Uncovering Volcanic Structures: For several geological problems there is considerable interest represented by the detection of a local component along with the regional component and construction of corresponding maps. In this case residual anomalies are assumed to be characterized by essential deviations of initial data from the regional component (from the trend surface) computed at points of sampling. The deviations from the trend surface depend on both the total influence of locally appearing geological factors and the 'noise', the value of autocorrelation in deviations and their relative contributions; Part 2 - Evolution of Rift-Zone Volcanism: The development of rift zones is accompanied by strong manifestations of volcanism. Rift genesis and magma genesis are both conditioned by processes taking place in the upper mantle. New data from the ocean floor permit carrying out a comparative analysis of the volcanism in continental and oceanic rift zones with the aim of determining similarities of differences in their development. GRA

N77-22931# Stanford Univ., Calif. Dept. of Statistics.
ESTIMATION OF THE PARAMETERS OF FINITE LOCATION AND SCALE MIXTURES
Javad Behboodian Oct. 1976 17 p refs
(Contract N00014-75-C-0442; NR Proj. 042-034)
(AD-A033269; SU-TR-28) Avail: NTIS HC A02/MF A01 CSCL 12/1

A finite location mixture is represented as the sum of two independent random variables, and a finite scale mixture is represented as the product of two independent random variables. Using these representations, it is shown how to generate random samples from these mixtures, how to prove their identifiabilities, and how to estimate the unknown parameters. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N77-22932# Michigan Univ., Ann Arbor. Dept. of Industrial and Operations Engineering.
ANALYSIS AND SIMPLIFICATIONS OF DISCRETE EVENT SYSTEMS AND JACKSON QUEUEING NETWORKS Ph.D. Thesis
Benjamin Melamed Sep. 1976 333 p refs
(Contract N00014-75-C-0492; Grant AF-AFOSR-2903-76)
(AD-A033290; TR-76-6) Avail: NTIS HC A15/MF A01 CSCL 12/2

This dissertation contains studies in two related areas: Discrete Event Systems Theory and Queueing Network Theory. In the first line of study, deterministic discrete event systems are modeled by formal automata-like structures, and a hierarchy of morphic relations among them is developed. A canonical representation of stochastic discrete event systems in coordinate probability space is proposed, and a hierarchy of morphic relations among them is constructed by means of measure preserving transformations. In the second line of study, several operating characteristics of the class of Jackson queueing networks are investigated. Included are: line sizes (network state), total service awarded to customers, and traffic processes on the arcs. Special emphasis is placed on rigorous derivations of results from solid mathematical and statistical foundations. In the process, a number of theoretical gaps in the extant theory of state equilibrium are closed, and Burke's Theorem is extended from M/M/1 queues to Jackson networks with single server nodes. GRA

N77-22933# Michigan Univ., Ann Arbor. Dept. of Electrical and Computer Engineering.
SELECTED PROBLEMS IN SYSTEM ENGINEERING Final Report
William A. Porter Oct. 1976 10 p refs
(Grant AF-AFOSR-2427-73)
(AD-A032997; AFOSR-76-1162TR) Avail: NTIS HC A02/MF A01 CSCL 12/2

This final scientific report describes the research carried out in three areas of system science: (a) the several notions of

causality and their connections with stability, sensitivity, and optimality; (b) various questions regarding polynomic operators, a useful class of operators that contains the linear operators; and (c) the modeling of arbitrary systems by simpler systems of a specified type. Author (GRA)

N77-22934# Southern Methodist Univ., Dallas, Tex. Dept. of Industrial Engineering and Operations Research.
RECURSIVE RELATIONS IN THE COMPUTATION OF THE EQUILIBRIUM RESULTS OF FINITE QUEUES
Sagi N. Ragu and U. Narayan Bhat Sep. 1976 36 p refs
(Contracts N00014-72-A-0296-003; N00014-75-C-0517; NR Proj. 042-324)
(AD-A032661; IEOR-76015) Avail: NTIS HC A03/MF A01 CSCL 12/1

Imbedded Markov chains of finite queueing systems with unit jumps at regeneration points have an almost left triangular (in system of the type G/M/s/N - in Kendall notation modified to include system capacity) or an almost right triangular (in systems of the type M/G/1/N) structure. Using this structure, a fundamental recursion on the elements of the transition probability matrix is developed, which in turn helps derive first passage as well as equilibrium results in computationally feasible forms. The computational procedure is illustrated using the system G/M/s/N with two arrival classes and priority service.
Author (GRA)

N77-22935# Stanford Univ., Calif. Dept. of Operations Research.
INDIVIDUAL AND SOCIAL OPTIMIZATION IN BIRTH-DEATH CONGESTION SYSTEM WITH A GENERAL COST-BENEFIT STRUCTURE
Niels Chr. Knudsen (Odense Univ., Denmark) and Shaler Stidham, Jr. (North Carolina State Univ., Raleigh) 20 Oct. 1976 24 p refs
(Contract N00014-76-C-0418; Grant NSF ENG-75-14847; NR Proj. 047-061)
(AD-A033267; SU-TR-70) Avail: NTIS HC A02/MF A01 CSCL 12/2

The authors consider optimal control of the arrival process to a stochastic congestion system modelled as a birth-death process, with arbitrary birth (arrival) and death (service) rates. An arriving customer who enters the system receives a net benefit which is decreasing in the number of customers already present. Control policies of a critical-number form are examined from the standpoint of individual optimization, social optimization, and facility optimization, with no discounting (average-return criterion). Previous results of Naor and Knudsen are generalized. In particular, the authors give a simple proof, in a more general setting, that fewer customers are admitted under social optimization than individual optimization. Sufficient conditions are given for the unimodality of the average-return function, and hence, for a local (social) optimum to be global. For the case of linear holding cost, it is shown that the presence of congestion is appropriately characterized by an average-decreasing service rate, a weaker condition than concavity. Applications include certain traffic-flow and computer systems, as well as classical queueing systems. GRA

N77-22936# California Univ., Berkeley. Operations Research Center.
OPPORTUNISTIC REPLACEMENT POLICIES FOR MAINTAINED SYSTEMS
Davinder P. S. Sethi Sep. 1976 62 p refs
(Contract N00014-75-C-0781; Grant DAAG29-76-G-0042)
(AD-A032866; ORC-76-26) Avail: NTIS HC A04/MF A01 CSCL 12/2

Consider a unit in continuous operation. When this unit fails, it is immediately replaced. In addition, opportunities arise according to a renewal process when either this unit is replaced at a reduced cost or do nothing. The problem is formulated as a Markov decision process. If the unit has increasing failure rate, the replacement policy that minimizes the expected total discounted cost or the average cost of maintenance is characterized by a single parameter i^* : If an opportunity exists, the working unit is replaced only if its age exceeds i^*. Techniques to compute the minimum discounted cost and the optimal policy are suggested. Under this simple replacement policy structure, the operating characteristics of the system are discussed for the special case where the opportunities arise according to an exponential arrival process. A series system of two units where the failure of either unit is also an opportunity to replace the other unit at a reduced cost is considered. When the units have increasing failure rate, the structure of the optimal policy is again determined. Author (GRA)

N77-22937# Pacific-Sierra Research Corp., Santa Monica, Calif.
SEARCH FOR MOVING TARGETS Final Report, 1 Apr. - 30 Sep. 1976
Anthony P. Ciervo Nov. 1976 75 p refs
(Contract N00014-76-C-0792)
(AD-A033214; PSR-619) Avail: NTIS HC A04/MF A01 CSCL 15/1

A fundamental problem in the theory of search involves the calculation of the probability of detection for searchers following known paths while attempting to detect a target whose motion is characterized statistically. The searchers' laws of detection and the target's initial distribution are given. Hellman has solved the problem when provided a Fokker-Planck equation for target motion, an unlikely input for military applications. The author solves the problem using the transition probabilities directly, and presents a closed-form expression for the probability of detecting a fleeing datum with an arbitrary search density. This solution is used to perform a gradient optimization for placement of stationary searchers in an antisubmarine warfare context. GRA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

No abstracts in this category.

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N77-22938# Energy Research and Development Administration, Washington, D.C.
SUPERCONDUCTING MAGNET RESEARCH IN THE MAGNETIC FUSION ENERGY PROGRAM
12 Feb. 1976 8 p
(ERDA-76-105) Avail: NTIS HC A02/MF A01

Recommendations are given to (1) define and characterize the minimum perceived long range need of the magnetic fusion program for future superconducting magnet materials, (2) offer an evaluation of the prospects for realizing such a material on a time scale appropriate to the fusion program, and (3) suggest a method of implementing a program aimed at achieving the goal. ERA

71 ACOUSTICS

Includes sound generation, transmission and attenuation.

For noise pollution see *45 Environment Pollution*.

N77-22939# Environmental Protection Agency, Washington D.C. Office of Noise Abatement and Control.
NOISE STANDARDS FOR AIRCRAFT TYPE CERTIFICATION (MODIFICATIONS TO FAR PART 36) Final Report
William C. Sperry and Damon C. Gray Aug. 1976 293 p refs
(PB-262401/3; EPA-550/9-76-013) Avail: NTIS HC A13/MF A01 CSCL 13B

Background data used by the EPA in the development of proposed noise control regulations for promulgation by the FAA

in conformance with the Noise Control Act of 1972 are presented. Regulations pertaining to control of airplane noise at the source are proposed as amendments to the existing certification regulation for aircraft noise. The modification is a comprehensive rule containing highly technical appendices whose purposes are to require the maximum feasible use of noise control technology, to set standards for the acquisition of noise levels, and to obtain data useful for predicting the noise impact in airport neighborhood communities. GRA

N77-22940# Army Construction Engineering Research Lab., Champaign, Ill.
THE STATISTICS OF AMPLITUDE AND SPECTRUM OF BLASTS PROPAGATED IN THE ATMOSPHERE, VOLUME 1
P. D. Schomer, R. J. Goff, and L. M. Little Nov. 1976 68 p refs
(DA Proj. 4A1-62121-A-896)
(AD-A033475; CERL-TR-N-13-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 13/2

This report presents the results of a study of blast propagation in the atmosphere. Detailed blast noise measurements and information on meteorological conditions gathered at Fort Leonard Wood, Mo were used to develop blast propagation statistics. The relationship between the specific meteorological and terrain conditions at Fort Leonard Wood and the measured blast amplitudes was established, as were frequency-weighted one-third octave spectra for use in predicting community response to blast noise. The weather and terrain dependence of blast propagation implies that the data gathered at Fort Leonard Wood can be used to predict blast amplitudes under similar conditions at other locations and to suggest possible relationships between general weather conditions and blast statistics. Author (GRA)

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N77-22941# Idaho National Engineering Lab., Idaho Falls.
ETOP 14, A FORTRAN CODE TO PROCESS ENDF/B DATA INTO THE 68-GROUP PHROG LIBRARY FORMAT
R. A. Grimesey, G. L. Singer, and D. A. Millsap Jul. 1976 312 p refs
(Contract E(10-1)-1375)
(ANCR-1322) Avail: NTIS HC A14/MF A01

ETOP 14 processes neutron cross section data from the ENDF/B format to the 68-group PHROG fast spectrum code. Major changes have accompanied modifications in the ENDF/B format and modifications to the PHROG code necessitated by changes in the ENDF/B format. A large number of program changes were made to increase the program's efficiency and accuracy in treating specific cross sections. The present version of the program will process all Version 4 ENDF/B formats except the Adler-Adler multilevel resonance formula. ETOP 14 calculates infinitely dilute capture and fission cross sections and an infinitely dilute elastic scattering matrix for these materials over the resonance range. This limitation will be corrected in the near future. Some reaction cross sections which are only prominent above 10 MeV are ignored by ETOP 14. The code in its present form can be easily extended above 10 MeV. ERA

N77-22942# GTE Labs., Inc., Waltham, Mass.
NANOSECOND BREAKDOWN IN LIQUIDS
J. M. Proud Sep. 1976 17 p refs
(Contract N00014-74-C-0215)
(AD-A031600; TR-76-875.1; TR-3) Avail: NTIS HC A02/MF A01 CSCL 20/3

The statistical properties of nanosecond time lags in the high field breakdown of several liquids have been investigated. The observed time lags are distributed in a manner which is characteristic of the molecule composing the liquid. The initiating mechanisms may involve molecular orientation at the liquid-electrode interface. Author (GRA)

N77-22943# Indiana Univ., Bloomington. Dept. of Chemistry.
SATURATION OF ENERGY LEVELS IN ANALYTICAL FLUORESCENCE SPECTROMETRY. 1: THEORY Interim Technical Report
D. R. Olivares Dec. 1976 53 p refs Submitted for publication
(Contract N00014-76-C-0838; Grant NSF MPS-75-21695)
(AD-A033543; TR-3) Avail: NTIS HC A04/MF A01 CSCL 07/4

The potential importance of energy-level saturation to analytical atomic fluorescence spectrometry has prompted a two-part fundamental investigation into the saturation process. The first part, reported here, develops a model for saturation which is applicable to both resonance and non-resonance fluorescence of atoms in flames or other gaseous media. Provision is made for considering both collisional excitation and quenching of atoms, and the exciting source can be chosen to be of any desired duration. To illustrate the utility of the model, values are predicted for the source spectral power density necessary to saturate several analytically important atomic transitions. Application of the model requires only a knowledge of the kinetic parameters of the energy levels being proved, including Einstein coefficients and quenching rates. Assumptions implicit in the model are discusssed and its sphere of valid application considered. Experimental verification of the model will be reported in part 2. Author (GRA)

N77-22944# Naval Intelligence Support Center, Washington, D. C. Translation Div.
SPECTRA OF DIFFUSE REFLECTION AS AN INFORMATION SOURCE ABOUT THE ABSORPTION SPECTRA OF ABSORBED MOLECULES
Ye. I. Kotov 1 Sep. 1976 9 p refs Transl. into ENGLISH from Teor. Prikl. Probl. Rasseyaniya Sveta (USSR), 1971 p 387-395
(AD-A032547; NISC-Trans-3842) Avail: NTIS HC A02/MF A01 CSCL 07/4

Optical spectral methods are being ever increasingly used in investigations of adsorption and catalysis where objects characterized by strong light scattering are encountered. Among these objects are disperse powders of solid substances having a particle size of 10-250 micrometers on whose surface molecules are adsorbed. The adsorption of molecules, the formation of transition compounds and end products as the result of a heterogeneous catalytic reaction are manifested in optical electron spectra which reflect the state of the outer electrons of the molecules and atoms and contain valuable information on the mechanism of processes acting on the surface. GRA

N77-22945# Purdue Univ., Lafayette, Ind.
A SHOCK TUBE STUDY OF THE RECOMBINATION OF CARBON MONOXIDE AND OXYGEN ATOMS Technical Report, Apr. - Oct. 1976
Anthony M. Dean and Don C. Steiner Oct. 1976 28 p refs Prepared by Missouri Univ., Columbia
(Contract N00014-75-C-1143; Proj. SQUID; NR Proj. 098-038)
(AD-A032494; SQUID-TR-UMO-1-PU) Avail: NTIS HC A03/MF A01 CSCL 07/4

For some time now this laboratory has been utilizing nitrous oxide as a high temperature source of oxygen atoms. Recently, an independent technique has been used to calibrate the detector system for oxygen atoms. With this calibration factor known, more refined experiments have been performed in which the absolute oxygen atom concentration can be monitored as a function of time. It was found that only slight modifications of earlier rate constant assignments were required to quantitatively explain these new results. In this light it is now felt that the dissociation kinetics of N2O are reasonably well understood. Thus the CO2 production rate in N2O/CO mixtures has been measured in an attempt to determine k sub r. It is shown that small amount of impurities can drastically affect the CO2 production rate. Analysis of this impurity effect has yielded estimates of the actual recombination rate constant between 2100 and 3200 K. The value of k sub r determined in this way is shown to be consistent with the recent measurements of k sub d reported by Wagner, and Kiefer, which yielded normal activation energies for CO2 dissociation. GRA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N77-22946# General Atomic Co., San Diego, Calif.
MIRROR HYBRID REACTOR BLANKET AND POWER CONVERSION SYSTEM CONCEPTUAL DESIGN
K. R. Schulte, G. A. Backus, C. B. Baxi, J. B. Dee, E. A. Estrine, R. Rao, and A. R. Veca 29 Jun. 1976 33 p refs Presented at Joint US-USSR Symp. on Fusion Fission Reactor, Livermore, Calif., 13 Jul. 1976
(GA-A-14008; Conf-760733-1) Avail: NTIS HC A03/MF A01

The conceptual design of the blanket and power conversion system for a gas-cooled mirror hybrid fusion-fission reactor is presented. The designs of the fuel, blanket module, and power conversion system are based on existing gas-cooled fission reactor technology. The uranium silicide fuel is contained in Inconel-clad rods and is cooled by helium gas. The fuel is contained in 16 spherical segment modules which surround the fusion plasma. The hot helium is used to raise steam for a conventional steam cycle turbine generator. The details of the method of support for the massive blanket modules and helium ducts remain to be determined. A preliminary safety analysis shows that with the development of a satisfactory method of primary coolant circuit containment and support, the hybrid reactor could be licensed under existing Nuclear Regulatory Commission regulations. ERA

N77-22947# General Atomic Co., San Diego, Calif.
CONCEPTUAL DESIGN OF THE BLANKET AND POWER CONVERSION SYSTEM FOR A MIRROR HYBRID FUSION-FISSION REACTOR 12-Month Progress Report, 1 Jul. 1975 - 30 Jun. 1976
K. R. Schultz, C. B. Baxi, and R. Rao 6 Jul. 1976 212 p refs 2 Vol.
(Contract E(04-3)-0167-PRJ-38)
(GA-A-14021) Avail: NTIS HC A10/MF A01

The conceptual design and preliminary feasibility assessment are presented for the hybrid blanket and power conversion system of the Mirror Hybrid Fusion-Fission Reactor. Existing gas-cooled fission reactor technology is directly applicable to the Mirror Hybrid Reactor. Aspects of the present conceptual design that require further design and analysis effort are listed. ERA

N77-22948# Naval Research Lab., Washington, D. C.
REALIZATION OF A RELATIVISTIC MIRROR: ELECTROMAGNETIC BACKSCATTERING FROM THE FRONT OF A MAGNETIZED RELATIVISTIC ELECTRON BEAM Interim Report
V. L. Granatstein, P. Sprangle, R. K. Parker, J. Pasour, M. Herndon, S. P. Schlesinger, and J. L. Seftor (Sci. Appl., Inc., McLean, Va.) Sep. 1976 33 p refs
(AD-A031556; NRL-MR-3373) Avail: NTIS HC A03/MF A01 CSCL 20/3

An intense relativistic electron beam has been injected into a cylindrical drift tube containing a counterstreaming electromagnetic wave (f sub i = 9.3 GHz and P sub i = 170 kW). Within a narrow range of axial magnetic field centered at 5 kG, a reflected wave at f sub s approximately 40 GHz was generated by the interaction of the beam with the incident wave. The reflected wave was observed to have a power of several hundred kilowatts (i.e. greater than the power of the incident wave) and a pulse duration on the order of nanoseconds. All observed experimental characteristics (viz. frequency shift, power amplification, pulse duration, and cyclotron resonance) were consistent with a model of reflection from the discontinuity in refractive index that is associated with an electron beam front near cyclotron resonance. This mechanism could be employed in a new class of short-pulse, ultra-high power, tunable generators at millimeter and submillimeter wavelengths. Author (GRA)

N77-22949# Harry Diamond Labs., Adelphi, Md.
ELECTRON-BEAM-INDUCED DAMAGE IN PAINT SAMPLES
Gary L. Skillington, Dale R. Schallhorn, William D. Scharf, Robert B. Oswald, Jr., and Timothy R. Oldham Nov. 1976 19 p refs Sponsored by Defense Nuclear Agency
(AD-A032682; HDL-TM-76-39) Avail: NTIS HC A02/MF A01 CSCL 11/3

Electron-beam-induced damage was investigated in paints that are being developed as protective coatings for missiles. The electron-beam testing of the paints had four objectives: (1) to determine, by establishing the damage threshold and mode, if low-level stress would cause pop-off, (2) to determine the impulse as a function of fluence, (3) to determine the mass loss as a function of fluence, and (4) to determine the Gruneisen parameter for the paints. The tests showed that the damage mode was not low-stress-level pop-off, but spall at a fluence of 30 to 40 cal/sq cm incident on the filters. The tests showed also that the impulse as a function of fluence is steplike. At 25 to 30 cal/sq cm fluence, the impulse is too small to be measured, but at 40 cal/sq cm it increases to about 1 kilotap and remains essentially at that level at higher fluences. By using stress-time measurements, the Gruneisen parameter was calculated to be 0.37 if crushup and plastic work are neglected. This value, therefore, represents a lower bound on the parameter. Both impulse and the mass-loss data showed large variations at each fluence level. Further analysis indicated that these data variations were caused by experimental problems resulting primarily from the use of the filters and the wide variation in the response of the different paint samples. Author (GRA)

74 OPTICS

Includes light phenomena.

N77-22950* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OPTICAL INSTRUMENT EMPLOYING RETICLE HAVING PRESELECTED VISUAL RESPONSE PATTERN FORMED THEREON Patent
Richard F. Haines, inventor (to NASA) Issued 19 Apr. 1977 8 p Filed 8 Mar. 1976 Supersedes N76-20959 (14 - 11, p 1455)
(NASA-Case-ARC-10976-1; US-Patent-4,018,533; US-Patent-Appl-SN-665032; US-Patent-Class-356-171) Avail: US Patent Office CSCL 20F

An optical instrument for use in locating indicator lights or the like on a work surface is described. It comprises a tubular housing, a lens mounted within the housing and including an inner surface coated with a dichroic material that is capable of reflecting a portion of the light incident thereon, a plate mounted within the housing opposite the lens and having a central aperture, a transparent substrate disposed within the housing intermediate the lens and the plate, the substrate including a first surface disposed in a facing relationship to the dichroic material, and a reticle formed on the first surface and comprised of a material capable of reflecting light.
Official Gazette of the U.S. Patent Office

N77-22951* National Aeronautics and Space Administration. Pasadena Office, Calif.
SUN DIRECTION DETECTION SYSTEM Patent
Louis F. Schmidt (JPL) and George D. Pace, Jr., inventors (to NASA) (JPL) Issued 19 Apr. 1977 8 p Filed 24 Sep. 1975 Supersedes N75-33169 (13 - 24, p 3017) Sponsored by NASA
(NASA-Case-NPO-13722-1; US-Patent-4,018,532; US-Patent-Appl-SN-616472; US-Patent-Class-356-141; US-Patent-Class-250-211K; US-Patent-Class-250-203R; US-Patent-Class-356-152; US-Patent-Class-356-172) Avail: US Patent Office CSCL 20F

One of the detectors is an illumination detector consisting of two spaced apart elongated strips with a strip of cadmium sulphide (Cds) deposited therebetween. Whenever the line image impinges the CdS strip, the resistance between the two other strips is relatively low, while being high when the line image is outside the field of view of the illumination detector. Also included is a sun angle detector which consists of a vapor deposited resistor strip connected at one end to plus 10v and at the

other end to minus 10v. Spaced apart from the resistor strip is an elongated strip of low resistance material acting as an output strip, with a CdS strip between the two strips. When the line image is within the field of view of the sun angle detector, the output voltage at the output strip depends on the position of the line image across the sun angle detector.
Official Gazette of the U.S. Patent Office

N77-22952*# Avco Corp., Wilmington, Mass.
SPECTRAL EMISSIVITY OF METALS AFTER DAMAGE BY PARTICLE IMPACT Final Report
Tibor S. Laszlo and Richard E. Gannon 5 Sep. 1963 78 p refs
(Contract NAS8-1642)
(NASA-CR-150250; RAD-TR-63-39) Avail: NTIS HC A05/MF A01 CSCL 20F

The reflectance, R, solar absorption, alpha, thermal emittance epsilon, and the alpha/epsilon ratio were determined for several metals before and after bombardment by high velocity microprojectiles. Observed decreases of 1 to 26 percent in the reflectance of various metals were apparently dependent on the amount of surface area damaged as well as on the velocity of the impinging projectiles. The thermal emittance was observed to increase more than the solar absorptance, which resulted in a net decrease in the alpha/epsilon ratio in all metals investigated except stainless steel 304. In the case of stainless steel 304, alpha and epsilon were observed to increase equally, resulting in an alpha/epsilon ratio apparently insensitive to microprojectile bombardment. Recommendations for the continuation of these investigations are outlined. Author

N77-22953# Stanford Univ., Calif. Edward L. Ginzton Lab.
ACOUSTICALLY SCANNED OPTICAL IMAGING DEVICES Semiannual Report, 1 Jan. - 30 Jun. 1976
Gordon S. Kino Sep. 1976 47 p refs
(Contract N00014-76-C-0129; ARPA Order 2778)
(AD-A032443; SU-GL-2616; SAR-2) Avail: NTIS HC A03/MF A01 CSCL 17/8

A reliable and simple airgap convolver constructional technique using rail supports has been devised and tested. An array of v groove isolated mesa p-n diodes has been fabricated in silicon. This gives excellent isolation between the diodes. The results obtained on convolvers and optical imaging devices are in excellent agreement with the theory that has been developed. GRA

N77-22954# United Technologies Research Center, East Hartford, Conn.
BROADBAND AND HIGH POWER INFRARED WAVEGUIDE MODULATORS Final Technical Report, 25 Aug. 1972 - 15 Oct. 1976
P. K. Cheo, M. Gilden, and R. Wagner 15 Oct. 1976 58 p refs
(Contract N00014-73-C-0087; ARPA Order 1860)
(AD-A032808; UTRC/R-76-922241-4) Avail: NTIS HC A04/MF A01 CSCL 17/2

The objective of this program is to develop an efficient and reliable ultra-wideband waveguide modulator for CO2 lasers that will be useful for high resolution imaging optical radars and high-data-rate optical communication systems. Efficiency and reliability can be obtained by using integrated optics technology, which is an optical analog of IC technology in electronics. The major advantage of this approach is derived primarily from the fact that strong and wideband interaction between the laser and the microwave electric field can be obtained within a thin waveguiding layer at a thickness of approximately one optical wavelength. However, the practicality and applicability of this approach remained to be proven. Of most importance is the ability to demonstrate that the ultimate performance of an integrated-optic modulator can supersede that of the conventional bulk modulators. GRA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N77-22955# Techtran Corp., Silver Spring, Md.
SUPERFAST HEATING OF DENSE PLASMA IN LINEAR THETA-PINCH
V. A. Burtsev, V. N. Litunovskii, B. V. Lublin, G. M. Makeev, V. A. Ousyannikov, V. F. Prokopenko, V. G. Smirnov, and V. P. Fedyakova 22 Jul. 1976 23 p Transl. into ENGLISH from Russian report, K-0290
(ERDA-TR-191) Avail: NTIS HC A02/MF A01

The results of preliminary studies of the heating of dense plasma in a fast theta-pinch which are presented are of a quantitative nature. The experiments described were performed first with the aim of determining the essential feasibility of engineering decisions applied in the installation described above for obtaining fast rising magnetic fields, and their promise from the point of view of creating the conditions necessary for heating dense plasma in strong fields. GRA

N77-22956# Princeton Univ., N.J. Plasma Physics Lab.
KINETIC PROCESSES IN PLASMA HEATING BY RESONANT MODE CONVERSION OF ALFVEN WAVE
A. Hasegawa and L. Chen Sep. 1976 56 p refs
(Contract E(11-1)-3073)
(PPPL-1286) Avail: NTIS HC A04/MF A01

An externally applied oscillating magnetic field (at a frequency near one MHz for typical Tokamak parameters) resonantly mode converts to the kinetic Alfven wave, the Alfven wave with the perpendicular wavelength comparable to the ion gyroradius. The kinetic Alfven wave, while it propagates into the higher density side of the plasma after the mode conversion, dissipates due to both linear and nonlinear processes and heats the plasma. ERA

N77-22957# Energy Research and Development Administration, Washington, D.C. Div. of Magnetic Fusion Energy.
FUSION POWER BY MAGNETIC CONFINEMENT PROGRAM PLAN. EXECUTIVE SUMMARY
Jul. 1976 17 p 4 Vol.
(ERDA-76-110-0) Avail: NTIS HC A02/MF A01

A broad overview of the probable facilities requirements and optional possible technical paths to a demonstration reactor is presented, as well as a more detailed plan for the research and development program for the next five years. ERA

N77-22958# Energy Research and Development Administration, Washington, D.C. Div. of Magnetic Fusion Energy.
FUSION POWER BY MAGNETIC CONFINEMENT PROGRAM PLAN. VOLUME 2: LONG-RANGE PLANNING PROJECTIONS
Jul. 1976 129 p refs 4 Vol.
(ERDA-76-110-2) Avail: NTIS HC A07/MF A01

The technical, schedular, and budgetary projections for the development of fusion power using magnetic confinement are given. ERA

N77-22959# Energy Research and Development Administration, Washington, D.C. Div. of Magnetic Fusion Energy.
FUSION POWER BY MAGNETIC CONFINEMENT PROGRAM PLAN. VOLUME 3: FIVE-YEAR PLAN
Jul. 1976 252 p refs 4 Vol.
(ERDA-76-110-3) Avail: NTIS HC A12/MF A01

A brief historical review of the fusion program is given. Research achievements and problem areas are discussed for Tokamaks, magnetic mirror systems, and high density systems. The research program is described for magnet systems, plasma engineering, fusion reactor materials, and fusion systems engineering. The applied plasma physics program is described. ERA

N77-22960# Energy Research and Development Administration, Washington, D.C. Div. of Magnetic Fusion Energy.
FUSION POWER RESEARCH AND DEVELOPMENT PROGRAM PLAN. VOLUME 4: 5-YEAR PROGRAM, BUDGET

AND MILESTONE SUMMARIES
Jul. 1976 156 p 4 Vol.
(ERDA-76-110-4) Avail: NTIS HC A08/MF A01

Budget data are given for each of the Tokamak systems, mirror systems, and high density plasma systems for the years 1976 through 1982. All major facilities currently under ERDA contract are included. In addition, budget data are given for the development and technology program consisting of the following: (1) magnetic systems, (2) plasma engineering, (3) fusion reactor materials, (4) fusion systems engineering, (5) environment and safety, and (6) applied plasma physics. ERA

N77-22961# Princeton Univ., N.J. Plasma Physics Lab.
COUNTERSTREAMING-ION-TOKAMAK FISSILE BREEDER
D. L. Jassby and J. D. Lee Aug. 1976 11 p refs Presented at Joint US-USSR Symp. on Fusion-Fission Reactors, Livermore, Calif., 13 Jul. 1976
(Contract E(11-1)-3073)
(MATT-1255; Conf-760733-3) Avail: NTIS HC A02/MF A01

Tokamak plasmas fueled and heated by energetic neutral atom beams are characterized by total ion energy greatly exceeding the electron energy. For smaller devices, the largest fusion reactivity of energetic-ion plasmas is obtained when oppositely injected D(0) and T(0) beams sustain counterstreaming velocity distributions of deuterons and tritons. The net fissile and power productions of a Tokamak fusion-fission reactor are investigated with a counterstreaming-ion fusion driver and a fertile blanket optimized for fissile breeding. The blanket contains a fast-fission zone of natural U plus Mo (7 percent), followed by a Li-bearing zone for T breeding. The reactor produces a net power of 480 MWe and supplies sufficient Pu to support a system of LWR's producing 3800 MWe, with an estimated electrical energy cost for the entire system of 27 mills/kWh. ERA

N77-22962# Princeton Univ., N.J. Plasma Physics Lab.
NONLINEAR TEARING MODES IN TOKAMAKS
R. B. White, D. A. Monticello, M. N. Rosenbluth, and B. V. Waddell Sep. 1976 12 p refs Presented at 6th Intern. Conf. on Plasma Phys. and Controlled Nucl. Res., Berchtesgaden, West Germany, 6 Oct. 1976
(Contract E(11-1)-3073)
(PPPL-1282; Conf-761012-24) Avail: NTIS HC A02/MF A01

Numerical codes were developed for the description of the nonlinear evolution of tearing modes in tokamaks. The m = 1 mode is observed to continue rapid growth in the nonlinear regime, producing significant changes on a time scale consistent with the experimentally observed minor disruption. The double tearing mode associated with a hollow current profile also continues rapid growth in the nonlinear regime, and thus may play a significant role in the anomalous current penetration during the early stages of a tokamak discharge. Single magnetic islands with m greater than or equal to 2, on the other hand, cease exponential growth upon entering the nonlinear regime and saturate shortly thereafter. A model for the saturation processes is presented. Modifications due to thermal transport are discussed. ERA

N77-22963# Rensselaer Polytechnic Inst., Troy, N.Y.
ION BEAM PROBE PLASMA DIAGNOSTIC SYSTEM Annual Progress Report, 1 Feb. 1975 - 31 Jan. 1976
W. C. Jennings, K. A. Connor, and R. L. Hickok Jan. 1976 66 p refs
(Contract E(11-1)-2229)
(COO-2229-24; RPDL-76-1) Avail: NTIS HC A04/MF A01

Progress made in the program to develop heavy ion beam probe diagnostic systems for high energy, magnetically confined plasmas is reported. Topics discussed include: refinements made in the techniques for making spatially resolved instability measurements by continuing the study of a Kelvin-Helmholtz mode in an energetic arc; a 1 MHz data handling system using buffer storage developed for use with the Tokamak facility; a beam trajectory programmer developed for controlling the position of the probing beam in the plasma; and the concept of using a beam probe for mapping general magnetic fields. ERA

N77-22964# Princeton Univ., N.J. Plasma Physics Lab.
THEORETICAL AND EXPERIMENTAL STUDY OF PLASMA-WAVE COUPLING AND PROPAGATION USING PHASED WAVEGUIDE ARRAYS AND ELECTROSTATIC STRUCTURES
S. Bernabei, M. A. Heald, W. M. Hooke, R. W. Motley, F. J. Paoloni, M. Brambilla (Commissariat a l'Energie Atomique, Grenoble, France), and W. D. Getty (Michigan Univ., Ann Arbor) Sep. 1976 48 p refs
(Contract E(11-1)-3073)
(PPPL-1288) Avail: NTIS HC A03/MF A01

A theoretical and experimental study of the coupling and propagation of electron plasma waves excited by waveguide arrays and electrostatic structures is presented. The waves are excited in a low temperature, linear plasma column in a homogeneous magnetic field. Under appropriate conditions efficient coupling to plasma waves can be obtained. These studies are of relevance to plasma heating in that the modes are identical to those that must be generated in any lower hybrid heating experiment. ERA

N77-22965# Los Alamos Scientific Lab., N. Mex.
THETA PINCHES AND OTHER HIGH-BETA CONCEPTS
F. L. Ribe 1976 9 p Presented at 2nd ANS Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2099; Conf-760935-20) Avail: NTIS HC A02/MF A01

A review is given of the status of experiments on the Scyllac toroidal theta pinch, the Staged Theta Pinch, the Toroidal Reversed-Field Pinch, the Scylla IV-P Linear Theta Pinch, and the LASL 200-KJ coaxial gun. ERA

N77-22966# California Univ., Livermore. Lawrence Livermore Lab.
MIRROR REACTOR STUDIES
R. W. Moir, W. L. Barr, D. J. Bender, R. J. Burleigh, G. A. Carlson, R. S. Devoto, J. N. Doggett, J. H. Fink, G. W. Hamilton, and J. D. Lee 10 Aug. 1976 15 p refs Presented at 6th Intern. Conf. on Plasma Physics and Controlled Nucl. Fusion Res., Berchtesgaden, West Germany, 6-13 Oct. 1976
(Contract W-7405-eng-48)
(UCRL-78122) Avail: NTIS HC A02/MF A01

Design studies of a fusion mirror reactor, a fusion-fission mirror reactor, and two small mirror reactors are summarized. The fusion reactor uses 150-keV neutral-beam injectors based on the acceleration of negative ions. The injectors provide over 1 GW of continuous power at an efficiency greater than 80 percent. The fusion reactor has three-stage, modularized, Venetian blind, plasma direct converter with a predicted efficiency of 59 percent and a new concept for removal of the lune-shaped blanket: a crane is brought between the two halves of the Yin-Yang magnet, which are separated by a float. The design has desirable features such as steady-state operation, minimal impurity problems, and low first-wall thermal stress. The major disadvantage is low Q resulting in high recirculating power and hence high cost of electrical power. However, the direct capital cost per unit of gross electrical power is reasonable - $100/kw(e). ERA

N77-22967# California Univ., Livermore. Lawrence Livermore Lab.
FIELD-REVERSED MIRROR AS A D-T POWER REACTOR
W. C. Condit 24 Sep. 1976 14 p refs Presented at 2nd ANS Topical Meeting on the Technology of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-48)
(UCRL-78082; Conf-960935-7) Avail: NTIS HC A02/MF A01

The Field-Reversed-Mirror is a plasma confinement scheme which uses the diamagnetic current of the D-T fuel plasma to convert the open field pattern of a conventional mirror machine into a closed-field pattern with plasma confinement properties which are expected to be considerably improved. If realized, this improvement in confinement will considerably improve the energy gain of the mirror reactor, and result in a reduction in the cost of producting energy. The Field Reversed Mirror device is described and compared with earlier field-reversed configurations, and the overall energy and particle balance relations are given. Based on this, preliminary engineering design calculations of the major components of an FRM reactor are presented. A

cost optimization performed, and the optimum DT reactor is found to have a fusion output of 23 MW/cell from a plasma radius 5 cm, length 15 cm, in a field of roughly 10 Tesla. ERA

N77-22968# General Atomic Co., San Diego, Calif.
DESIGN CONSIDERATIONS FOR A NONCIRCULAR TOKAMAK DEMONSTRATION PLANT
D. Kearney, R. Bourque, W. Chen, J. Dalessandro, R. Hager, B. McHarg, M. Mintz, S. Rosenwasser, K. R. Schultz, and R. Thomas 20 Aug. 1976 14 p refs Presented at the 2d ANS Topical Meeting on the Technol. of Controlled Nuclear Fusion, Richland, Washington, 21-23 Sep. 1976
(Contract E(04-3)-0167)
(GA-A-14074) Avail: NTIS HC A02/MF A01

Design studies were carried out to identify and evaluate technological problems and examine alternatives for an initial conceptual design of a noncircular Tokamak demonstration power reactor. It was shown that a demonstration power plant can exhibit high net efficiency, a tritium breeding ratio greater than or equal to 1, and can provide the basis for technological and economic scaling to commercial plants. The emphasis was to examine areas unique to noncircular Tokamaks. The important systems and technological tradeoffs made to arrive at a consistent, feasible reactor design are discussed along with commercial plant requirements, the low-exposure maintenance concept, the tritium handling system, the flowing plasma boundary impurity control, the field-shaping coil design, and the blanket and shield designs. ERA

N77-22969# Oak Ridge National Lab., Tenn.
TOKAMAK PLASMA MAGNETICS
J. D. Callen, J. F. Clarke, and R. A. Dory 1976 32 p refs Presented at 6th Intern. Conf. on Plasma Phys. and Controlled Nucl. Fusion Res., Berchtesgaden, West Ger., 6 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761012-18) Avail: NTIS HC A03/MF A01

High beta (approximately 5-30 percent) Tokamak equilibria and the external magnetic field structures required to attain and hold them are discussed. The high beta equilibria are shown to be a natural consequence of intense heating by some auxiliary power source such as neutral beams, as long as the heating is rapid compared to the magnetic diffusion time scale. For slightly D-shaped cross sections, simple and efficient poloidal field systems are described which properly control and shape the plasma, and admit poloidal divertors at the apexes of the natural D-shaped cross sections. The poloidal field system also has the property (STATIC concept) of shielding (by a factor of about 6) superconducting toroidal field coils from flux changes. Finally, the toroidal field ripple effects that enhance the ion heat conduction and cause a substantial fraction of alpha particles to drift out of the plasma are briefly discussed. ERA

N77-22970# California Univ., Livermore. Lawrence Livermore Lab.
THE 2XIIB PLASMA CONFINEMENT EXPERIMENTS
F. H. Coensgen, J. F. Clauser, and D. L. Correll 6 Aug. 1976 12 p refs
(Contract W-7405-eng-48)
(UCRL-78121) Avail: NTIS HC A02/MF A01

Results of 2XIIB neutral-beam injection experiments with plasma-stream stabilization are reported. The plasma stream is provided either by a pulsed plasma generator located on the field lines outside the plasma region or by ionization of neutral gas introduced at the mirror throat. In the latter case, the gas is ionized by the normal particle flux through the magnetic mirror. A method of plasma startup and sustenance in a steady-state magnetic field is reported in which the plasma stream from the pulsed plasma generator serves as the initial target for the neutral beams. After an energetic plasma of sufficient density is established, the plasma generator stream is replaced by the gas-fed stream. Lifetimes of the stabilized plasma increase, with plasma temperature in agreement with the plasma stabilization of the drift-cyclotron loss-cone mode. ERA

N77-22971# Princeton Univ., N.J. Plasma Physics Lab.
EXPERIMENTS ON THE ATC TOKAMAK
R. J. Goldston, E. Mazzucato, R. E. Slusher (Bell Telephone Labs., Murray Hill, N. J.), and C. M. Surko (Bell Telephone Labs., Murray Hill, N. J.) Sep. 1976 16 p refs Presented at the 6th Intern. Conf. on Plasma Physics and Controlled Nuclear Fusion Res., Berchtesgaden, West Germany, 6-13 Oct. 1976
(Contract E(11-1)-3073)
(PPPL-1290; Conf-761012) Avail: NTIS HC A02/MF A01

Electron density fluctuations were studied by microwave and CO2 laser scattering. Fluctuations with wavelength between 2 cm and 0.3 mm and with frequencies up to 1.5 MHz were observed. Their amplitude n/sub e//anti n/sub e/ is of the order of .01. Local measurements of the safety factor q and Z/sub eff/ are reported. The value of q was obtained from the shifts of injected ion orbits relative to the magnetic surfaces; Z/sub eff/ was obtained from the scattering rate of radially localized injected ions. Both these measurements indicate a peaking of Z/sub eff/ on axis. Measurements are presented of the parallel and anti-parallel fast neutral spectra which indicate very different profiles for T/sub i parallel/ and T/sub i anti-parallel/. ERA

N77-22972# Sandia Labs., Albuquerque, N.Mex.
MATERIAL EJECTION FROM SHOCK-LOADED FREE SURFACES OF ALUMINUM AND LEAD
J. R. Asay Oct. 1976 86 p refs
(Contract E(29-1)-789)
(SAND-76-0542) Avail: NTIS HC A05/MF A01

It is shown that material ejection from shocked surfaces can significantly degrade interferometer experiments. In particular, loss of both light intensity and contrast of interferometer signals can result from various scattering and absorption processes occurring in a cloud of ejected material. An experimental technique is presented which allows determination of the mass and velocity of material ejected from free surfaces during shock loading. The technique was applied to a study of mass ejection occurring naturally from shocked surfaces of two aluminium alloys and from lead. Surface defects, such as pits and scratches, are thought to strongly influence mass ejection in aluminum; whereas in lead, localized shock-induced melting and vaporization are thought to be the dominant mechanisms at the higher shock pressures. ERA

N77-22973# Oak Ridge National Lab., Tenn.
PLASMA HEATING
J. D. Callen 1976 12 p refs Presented at the 2d Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-26)
(CONF-760935-10) Avail: NTIS HC A02/MF A01

The present technological and experimental status of auxiliary heating techniques in Tokamaks, mirrors, and pinches is reviewed. The possibility that these techniques can be extrapolated to fusion reactors is examined. ERA

N77-22974# Oak Ridge National Lab., Tenn.
OPERATION AND CONTROL OF HIGH DENSITY TOKAMAK REACTIONS
S. E. Attenberger and D. G. McAlees 13 Sep. 1976 24 p refs Presented at 2nd Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-26)
(CONF-760935-22) Avail: NTIS HC A02/MF A01

High density permits ignition in a relatively small, moderately elongated plasma with a moderate magnetic field strength. Under these conditions, neutron wall loadings approximately 4 MW/sq m must be tolerated. The sensitivity analysis with respect to impurity effects shows that impurity control will most likely be necessary to achieve the desired plasma conditions. The charge exchange sputtered impurities are found to have an important effect so that maintaining a low neutral density in the plasma is critical. If it is assumed that neutral beams will be used to heat the plasma to ignition, high energy injection is required (approximately 250 keV) when heating is accomplished at full density. A scenario is outlined where the ignition temperature is established at low density and then the fueling rate is increased to attain ignition. This approach may permit beams with energies being developed for use in TFTR to be successfully used to heat a high density device of the type described here to ignition. ERA

N77-22975# Los Alamos Scientific Lab., N. Mex.
TECHNOLOGY ASSESSMENT OF LASER-FUSION POWER PRODUCTION
L. A. Booth and T. G. Frank 1976 21 p refs Presented at 2nd Topical Meeting on the Technol. of Controlled Nucl. Fusion, Richland, Wash., 21 Sep. 1976
(Contract W-7405-eng-36)
(LA-UR-76-2060; CONF-760935-13) Avail: NTIS HC A02/MF A01

The inherent features of lase-induced fusion, some laser-fusion reactor concepts, and attendant means of utilizing the thermonuclear energy for commercial electric power generation are described. Theoretical fusion-pellet microexplosion energy release characteristics and the effects of pellet design options on pellet-microexplosion characteristics are discussed. The engineering feasibility of reactor cavities for which protection of cavity components is provided either by suitable ablative materials or by diversion of plasmas by magnetic fields is assessed. Two conceptual laser-fusion electric generating stations, based on different laser-fusion reactor concepts, are described. Technology developments for ultimate commercial application are outlined. ERA

N77-22976# Los Alamos Scientific Lab., N. Mex.
PLASMA EXPERIMENTS ON THE SCYLLA I-C THETA PINCH
K. F. McKenna Aug. 1976 11 p refs
(Contract W-7405-eng-36)
(LA-6397-MS) Avail: NTIS HC A02/MF A01

Scylla 1-C is a small scale (1-meter) research theta pinch developed for the experimental investigation of basic plasma physics processes and advanced concepts. The properties and stability characteristics of the Scylla I-C plasma, over a range of initial fill pressure from 100 to 500 mTorr Dsub2 are discussed. ERA

N77-22977# Princeton Univ., N.J. Plasma Physics Lab.
IMPLEMENTATION OF VERTICALLY ASYMMETRIC TOROIDAL-FIELD RIPPLE FOR BEAM HEATING OF TOKAMAK REACTOR PLASMAS
D. L. Jassby, G. V. Sheffield, H. H. Towner, and D. W. Weissenburger Oct. 1976 11 p refs Presented at 2d Topical Meeting on the Technol. of Controlled Nuclear Fusion, Richland, Wash., 21 Sep. 1976
(Contract E(11-1)-3073)
(PPPL-1292; Conf-760935-8) Avail: NTIS HC A02/MF A01

The neutral beam energy required for adequate penetration of Tokamak plasmas of high opacity can be reduced by a large factor if the beam is injected vertically into a region of large TF (toroidal field) ripple. Energetic ions are trapped in local magnetic wells and drift vertically toward the midplane (z = o). If the ripple is made very small on the opposite side of the midplane, drifting ions are detrapped and thermalized in the central plasma region. Design considerations are discussed for establishing the required vertically asymmetric ripple. Examples are given of special TF-coil configurations, and of the use of auxiliary coil windings to create the prescribed ripple profiles. ERA

N77-22978# Oak Ridge National Lab., Tenn.
CRYOGENIC INSTRUMENTATION NEEDS IN THE CONTROLLED THERMONUCLEAR RESEARCH PROGRAM
P. L. Walstrom Sep. 1976 12 p refs
(Contract W-7405-eng-26)
(ORNL/TM-5596) Avail: NTIS HC A02/MF A01

The magnet development effort for the controlled thermonuclear research program will require extensive testing of superconducting coils at various sizes from small-scale models to full-size prototypes. Extensive use of diagnostic instrumentation will be required to make detailed comparisons of predicted and actual performance in magnet tests and to monitor the test facility for incipient failure modes. At later stages of the program, cryogenic instrumentation will be required to monitor magnet system performance in fusion power reactors. Measured quantities may include temperature, strain, deflection, coil resistance, helium coolant pressure and flow, current, voltages, etc. The test environment which includes high magnetic fields (up to 8-10 T) and low temperature, makes many commercial measuring devices inoperative or at least inaccurate. In order to ensure reliable measurements, careful screening of commercial devices for performance in the test environment will be required. ERA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N77-22979# Sandia Labs., Albuquerque, N.Mex.
THERMOLUMINESCENCE OF ION-IMPLANTED SiO2
G. W. Arnold 1976 9 p refs Presented at 5th Intern. Conf. on Ion Implantation in Semicond. and Other Matter., Boulder, Colo., 9 Aug. 1976
(Contract E(29-1)-789)
(SAND-76-5345; Conf-760836-3) Avail: NTIS HC A02/MF A01

Thermoluminescence (TL) was measured from room temperature to 500 C for ion-implanted fused silica glasses, crystalline synthetic quartz and rf-sputtered SiO2 films. Measurements of the TL spectra for widely varying values of electronic and atomic energy depositions, along with the known impurity concentrations of the various systems, allowed some of the TL features to be identified. A TL peak at 150 C in fused silica was identified with defects formed by structural modification. A 330 C peak in crystalline quartz and relatively impure fused silica is tentatively assigned to a center involving Al. A 100 C peak, common to all silicas, may be related to oxygen vacancies. An approximately 200 C peak may be the analog of the 245 nm impurity absorption band seen in some fused silica glasses. ERA

N77-22980# Brookhaven National Lab., Upton, N.Y.
INCOMMENSURATE STRUCTURAL PHASE TRANSFORMATIONS
J. D. Axe 1976 25 p refs Presented at the Conf. on Neutron Scattering, Gatlinburg, Tenn., 6 Jun. 1976
(Contract E(30-1)-16)
(BNL-21496; Conf-760601) Avail: NTIS HC A02/MF A01

Some of the most interesting structural phase transformations under current study involve modes of atomic displacement that are incommensurate with the underlying lattice. In some cases, these transformations are driven by Fermi surface instabilities that also produce electronic charge density waves and soft phonon modes due to dielectric screening singularities. The periodic potential of the underlying lattice causes complex nonsinusoidal distortions of the condensed displacement waves, and may lead to subsequent transformations which lock in the period of the displacements with that of the lattice. Recent neutron scattering studies bearing on both static and dynamic aspects of incommensurate structural instabilities are reviewed. ERA

N77-22981# Sandia Labs., Albuquerque, N.Mex.
DEUTERIUM DEPTH PROFILES IN METALS USING IMAGING FIELD DESORPTION
J. A. Panitz 1976 23 p refs Presented at 23rd Natl. Vacuum Symp., Chicago, 21 Sep. 1976
(Contract E(29-1)-789)
(SAND-76-5579; Conf-760921-4) Avail: NTIS HC A02/MF A01

Depth profiles of 80 eV deuterium ions implanted in-situ into (110) tungsten were measured by imaging, field desorption, mass spectrometry. The relative abundance of deuterium was measured from the surface to a depth of 300A with less than 3A depth resolution by controlled field evaporation of the specimen, and time-of-flight mass spectroscopy. The position of the depth distribution maximum is shown to be in close agreement with that predicted theoretically for low energy deuterium implants using an amorphous-solid model. Structure in the distribution is attributed to surface morphology and channeling phenomena in the near surface region. Implanted impurity species from the ion source and tungsten surface were also observed. For C(1+), C(2+) and O(+) penetration is limited to less than 30A, with abundance decreasing exponentially from the surface. ERA

N77-22982# Arkansas Univ., Fayetteville. Dept. of Electrical Engineering.

INFRARED RESPONSE OF IMPURITY DOPED SILICON MOSFET'S (IRFET'S): FABRICATION AND CHARACTERIZATION OF THE GALLIUM DOPED INFRARED SENSING MOSFET Semiannual Technical Report, 1 Aug. 1975 - 1 Feb. 1976

Leonard Forbes Griffiss AFB, N. Y. RADC 1 Feb. 1976 94 p refs

(Contract F19628-75-C-0071; ARPA Order 2794)

(AD-A031425; RADC-TR-76-275; SATR-3) Avail: NTIS HC A05/MF A01 CSCL 17/5

Fabrication and characterization of the gallium doped infrared sensing MOSFET is described. Gallium doped MOSFET device structures have been fabricated by diffusion of gallium from doped oxide sources into n-channel MOSFET's fabricated on normal boron p-type substrates. The process developed produces double doped, both gallium and boron substrates. The characteristics of the gallium impurity center in silicon have been determined by measurements on the MOSFET device structure, and specifically the thermal emission rate of holes from neutral gallium centers determined. To the best of the author's knowledge the emission rate of gallium has not been previously measured. A very significant field enhancement has been observed in this thermal emission rate and is described by the Poole-Frenkel effect. Measurements have been made of the characteristics of the gallium doped MOSFET (IRFET) as an infrared detector. It has been found that the device operated according to previously published models and design criteria and in a manner consistent with that previously observed for the indium and gold doped devices. These results demonstrate that the gallium doped infrared sensing MOSFET (IRFET) will operate in the far infrared, * to 14 micrometer wavelength range, and as such might be particularly suited to large scale integrated infrared imaging arrays and applications. GRA

N77-22983# California Inst. of Tech., Pasadena. Div. of Chemistry and Chemical Engineering.

STRUCTURAL INFORMATION IN POLYCRYSTALLINE SYSTEMS VIA DIPOLAR MODULATED CHEMICAL SHIFT SPECTRA

M. E. Stoll, A. J. Vega, and R. W. Vaughn Oct. 1976 5 p refs Presented at 19th Ampere Congr., Heidelberg, 1976

(Contract N00014-75-C-0960)

(AD-A031512; TR-3) Avail: NTIS HC A02/MF A01 CSCL 20/2

NMR experiments on polycrystalline samples are discussed which allow determination of local structural information, bond angles, and bond distances, as well as furnish information to locate the principle axes of the chemical shift tensor in the molecular frame. Author (GRA)

N77-22984# Royal Institution of Great Britain, London.

NEW TECHNIQUES FOR INVESTIGATING PROPERTIES OF ENERGETIC SOLIDS AT HIGH STATIC AND DYNAMIC PRESSURES Final Technical Report, Sep. 1975 - Sep. 1976

George Porter, C. J. Tredwell, and H. D. Fair (Picatinny Arsenal, Dover, N. J.) Sep. 1976 21 p refs

(Grant DA-ERO-75-G-058)

(AD-A031558) Avail: NTIS HC A02/MF A01 CSCL 20/2

A microscopic technique for determining the optical properties of solids at static high pressures is described. The applied pressure is measured by evaluating the shift in the sharp R-line of the fluorescence spectrum of a ruby crystal. Stress waves induced by a Q-switched ruby laser pulse are investigated, and the feasibility of using picosecond light pulses to generate far larger pressure gradients is examined. Author (GRA)

N77-22985# Hughes Research Labs., Malibu, Calif.

MOLECULAR BASIC FOR LIQUID CRYSTAL FIELD EFFECTS Final Report, 1 May 1972 - 30 Jun. 1976

J. David Margerum Oct. 1976 142 p refs

(Contract F44620-72-C-0075)

(AD-A032820; AFOSR-76-1181TR) Avail: NTIS HC A07/MF A01 CSCL 07/4

The relationships between the molecular structure of liquid crystal (LC) components and dopants are studied in regard to the dynamic scattering (DS) electro-optical effects of nematic liquid crystals. Redox dopants which undergo electrochemically reversible reactions at lower potentials than the irreversible reactions of LC's are used to improve the dc-DS performance and stability. Two years of continuous dc-DS at 20 V is achieved by using such redox dopants in phenyl benzoate LC's. These redox dopants also give the LC lower threshold voltages and higher scattering levels for dc-DS than are obtained with organic salt dopants. Among the many electro-optical applications, of LC's, dynamic scattering is particularly useful for flat panel, TV-rate, matrix displays and for electronically addressed telescope reticles. GRA

N77-22986# Rockwell International Science Center, Thousand Oaks, Calif.

A 1.06 MICRON HIGH SENSITIVITY IR PHOTOCATHODE Final Report, 6 Jan. - 30 Jun. 1975

J. S. Harris, Jr., R. Sahai, J. R. Waldrop, and L. Bubulac Wright-Patterson AFB, Ohio AFAL Oct. 1976 75 p refs

(Contract F33615-75-C-1037; AF Proj. 2001)

(AD-A032818; SC5013.13FR; AFAL-TR-76-94) Avail: NTIS HC A04/MF A01 CSCL 17/5

The design and progress toward realization of a high sensitivity 1.06 micron field-assisted heterojunction photocathode are reported. Major emphasis has been placed on developing a Cs activation process for heterojunction devices and on a device fabrication technology which is consistent with Cs activation requirements. The first heterojunction devices (cold cathodes) were successfully activated, and emission into vacuum was observed. Further work in developing a heterojunction photocathode structure for activation is recommended in order to realize the complete device and demonstrate the potential of the heterojunction photocathode. Author (GRA)

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N77-22987# California Univ., Berkeley. Lawrence Berkeley Lab.

CORRELATION EXPERIMENTS AND THE NONVALIDITY OF ORDINARY IDEAS ABOUT THE PHYSICAL WORLD

H. P. Stapp Jul. 1976 7 p refs

(Contract W-7405-ENG-48)

(LBL-5333) Avail: NTIS HC A02/MF A01

It is shown that the predictions of quantum theory in certain correlations experiments are incompatible with ordinary ideas about the physical world. In particular the following theorem is proved: Consider situations involving two experimenters, one working in each of two space-like separated regions. Suppose each is apparently free to choose to perform in his region one of two alternative experiments. Assume that the results that would be obtained in each of the alternative cases conform to the statistical predictions of quantum theory. Then the experimental results in one region must, in some cases, depend on which experiment is performed in the space-like separated region. ERA

N77-22988# California Univ., Berkeley. Lawrence Berkeley Lab.

ATOMIC PHYSICS TESTS OF QUANTUM ELECTRODYNAMICS

Peter J. Mohr Aug. 1976 29 p refs Presented at the 5th Intern. Conf. on Atomic Physics, Berkeley, Calif., 26 Jul. 1976

(Contract W-7405-eng-48)

(LBL-5465; Conf-760730-3) Avail: NTIS HC A03/MF A01

The tests of quantum electrodynamics derived from bound systems and the free electron and muon magnetic moments are reviewed. The emphasis is on the areas in which recent developments in theory or experiment have taken place. Also determinations of the fine structure constant from the Josephson effect and the fine structure of helium are discussed. ERA

N77-22989# Du Pont de Nemours (E. I.) and Co., Aiken, S.C. Savannah River Lab.
THERMODYNAMIC PROPERITES OF STEAM AND WATER ADAPTED FOR THE IBM 360/195 COMPUTER
M. P. Burgess, G. L. Fuller, and A. H. Kaiser Sep. 1976 49 p refs
(Contract E(07-2)-1)
(DPSPU-76-11-3) Avail: NTIS HC A03/MF A01

The program STEAM67 was developed by the American Society of Mechanical Engineers; it is a collection of individual routines each designed for a specific problem. A second program, ASTEM, was developed by the Aerojet Nuclear Company; it is more general and provides information used to calculate specific solutions. The programs were tested on the IBM 360/195 computer and results compared with published values. ERA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N77-22990# Southeast Michigan Council of Governments, Detroit.
COASTAL RESOURCES MANAGEMENT: INTERGOVERNMENTAL AND INTERAGENCY COMMUNICATION
Aug. 1976 22 p
(PB-262965/7; NOAA-76121606) Avail: NTIS HC A02/MF A01 CSCL 13B

The impact of coastal zone management program implementation upon the need for, and the adequacy of existing mechanisms for intergovernmental and interagency information exchange opportunities must be provided for communication in conjunction with the implementation of a comprehensive program to protect and manage coastal resources. A mechanism is recommended to provide the state with area wide and local input on certain projects occurring in the coastal zone. GRA

N77-22991# Decisions and Designs, Inc., McLean, Va.
DIFFERENTIAL WEIGHTING IN MULTI-ATTRIBUTE UTILITY MEASUREMENT: WHEN IT SHOULD NOT AND WHEN IT DOES MAKE A DIFFERENCE
J. Robert Newman Aug. 1976 32 p refs Prepared by Univ. of Southern Calif., Los Angeles
(Contract N00014-76-C-0074; ARPA Order 3052)
(AD-A033182; SSRI-76-6) Avail: NTIS HC A03/MF A01 CSCL 05/10

Some of the conditions under which differential weighting in multi-attribute utility measurement may be used are explored. For the case of non-negatively correlated attributes, and under conditions when no well-defined criterion variable is available, differential weighting is not important. Unit or equal weighting will do just as well. For the case of some or all of the attributes being negatively correlated and when the negative signs cannot be removed by appropriate scaling, then differential weighting can make a difference. Thus, the final choice can be quite different depending upon what weighting scheme is used. An example of choosing a 'best' automobile from a set of automobiles is given. The practical implications of these results are discussed. Decision makers may wish to retain differential weighting even for the case in which it does not make a difference, but for psychological, not numerical reasons. Author (GRA)

N77-22992# Decisions and Designs, Inc., McLean, Va.
UNIT VERSUS DIFFERENTIAL WEIGHTING SCHEMES FOR DECISION MAKING: A METHOD OF STUDY AND SOME PRELIMINARY RESULTS Technical Report, Jul. 1975 - Sep. 1976
J. Robert Newman, David Seaver, and Ward Edwards Jul. 1976 41 p refs Prepared by Univ. of Southern Calif., Los Angeles
(Contract N00014-76-C-0074; ARPA Order 3052)
(AD-A033183; SSRI-76-5) Avail: NTIS HC A03/MF A01 CSCL 05/10

A method for generating realistic data is described, and illustrations of how the method can be used to study the efficacy of different data analysis models are given. The method is a Monte Carlo computer simulation of a multivariate process and generates a N by M data matrix where N is the number of observations and M is the number of variables or measurements. The computer program to accomplish this is outlined. Two examples of the use of the method are given. One compares the familiar multiple regression model with simple unit weighting in a well defined prediction problem. The results indicate that multiple regression is superior to unit weighting for prediction purposes, but the differences between the two models are not great. The second example compares several ways of forming weighted and unweighted composites in a multi-attribute decision making context. Some of the conditions in which differential weighting is important in such contexts are specified. Author (GRA)

N77-22993# Navy Personnel Research and Development Center, San Diego, Calif.
SIGNIFICANCE OF RISK IN NAVY TACTICAL DECISION MAKING: AN EMPIRICAL INVESTIGATION
Charles F. Gettys, Melvyn C. Moy, and Michael W. Obar Dec. 1976 87 p refs
(AD-A033583; NPRDC-TR-77-8) Avail: NTIS HC A05/MF A01

Research was conducted to determine the extent to which factors of risk are important in the use of operational decision aids. An empirical comparison was made between the performance of individuals using a decision aiding display developed by Decisions and Designs, Inc. (DDI), and the performance of these same individuals using a display developed by the Navy Personnel Research and Development Center (NPRDC). The DDI display was primarily designed to convey information about subjective expected utility (SEU) and does not explicitly present information about the 'risk' associated with each of the alternative acts the decision maker might select. The display contrived by NPRDC was designed to present information about risk as well as SEU. Subjects who benefited from the aids were those who became more aversive to risk when the necessity of a correct decision was increased. GRA

N77-22994# Michigan Univ. Ann Arbor. Inst. for Social Research.
FUTURE PERFORMANCE TREND INDICATORS: A CURRENT VALUE APPROACH TO HUMAN RESOURCES ACCOUNTING. REPORT 2: INTERNAL CONSISTENCIES AND RELATIONSHIPS TO PERFORMANCE IN ORGANIZATION VI
Patricia A. Percorella and David G. Bowers Oct. 1976 105 p refs
(Contract N00014-76-C-0362)
(AD-A033608) Avail: NTIS HC A06/MF A01 CSCL 05/1

This report describes analyses preparatory to construction of a suitable file for generating a system of future performance trend indicators. Such a system falls into the category of a current value approach to human resources accounting. It requires that there be a substantial body of data which: (1) Uses the work group or unit, not the individual, as the analysis unit, and which contains standard measures of the human oragnization and dollar-convertible performance measures, both with high internal consistency; and (2) Displays a high frequency of statistically significant relationships of human organization to performance measures. The report describes analyses which were conducted on data from 3 plants of a multi-location manufacturing organization. Internal consistency reliabilities of both human organization (survey) data and performance (total variable expenses and absence rate) were shown to be high, and a pattern of human organization-to-performance correlations resulted which are quite useable. With this data, the authors now have a base of 5 organizational data sets from which they

should be able to take the next steps: multiple regression, time lag and magnitude estimation, and value attribution. GRA

N77-22995# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences Management.
A MODEL INTERFACE FOR THE DECISION AIDING INFORMATION SYSTEM Interim Report
Ralph M. Mitchell, Jr. Sep. 1976 71 p refs
(Contract N00014-75-C-0440)
(AD-A033416; Rept-76-09-11) Avail: NTIS HC A04/MF A01 CSCL 05/1

Under the sponsorship of the Office of Naval Research, the Decision Aiding Information System is being developed at the Wharton School to provide a vehicle to assist the tactical level decision maker in bringing together available data, models and programs, and through and active role in user/system interactions improve the manager's decision making activities. In today's complex systems, models have the capacity to play an ever-expanding role in the decision environment, but a system was required that would provide the decision maker with information which will (a) lead the decision maker to the proper model for the situation, (b) automatically find and transfer the required data to the model, and (c) transfer results back to the decision maker in an easy to use form. This paper explains the development and implementation of a Model Interface Program to meet these requirements in order to provide a bridge to enable the manager to integrate mathematical models into his own decision processes. Author (GRA)

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software*.

N77-22996* + National Aeronautics and Space Administration, Washington, D. C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY. SECTION 1: ABSTRACTS
Jan. 1977 68 p
(NASA-SP-7039(10)) Avail: NTIS CSCL 05B

This continuing bibliography lists 189 patents and patent applications introduced into the NASA scientific and technical information system during the period July 1976 through December 1976. Each entry consists of a citation, an abstract, and in most cases, a key illustration from the document. Author

N77-22997# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
COMPUTERIZED LANGUAGE TRANSLATION AT ORNL
S. R. Jordan (Tenn. Univ., Knoxville), A. F. R. Brown (Control Data Corp., Sunnyvale, Calif.), and F. C. Hutton 1976 22 p refs Presented at Ann. Meeting of Am. Soc. Inform. Sci., San Francisco, 5 Oct. 1976
(Contract W-7405-eng-26)
(CONF-761011-1) Avail: NTIS HC A02/MF A01

A generalized language translation system used at Oak Ridge National Laboratory to translate Russian scientific text to English is discussed. Although the translations lack high literary quality, the system by means of its context-sensitive dictionary nevertheless provides inexpensive, fast, and highly useful translations of scientific literature. The method used is a linguistically-oriented programming language called SLC, with which a language-specific dictionary can be written for use by the translation system. The dictionary entry for any word can be augmented by procedures which permit its meaning to be modified by its contex; more general linguistic procedures operate on the sentence as a whole. In an evaluation of user reaction, over ninety percent of the respondents rated the machine translation service good or acceptable on translations of their subject specialty. ERA

N77-22998# California Univ., Berkeley. Lawrence Berkeley Lab.
ERDA INTERLABORATORY WORK FOR DATA EXCHANGE (IWGDE) Annual Report, Fiscal year 1976
Deane Merrill, ed. and Donald Austin, ed. Sep. 1976 138 p refs Revised
(Contract W-7405-eng-48)
(LBL-5329) Avail: NTIS HC A07/MF A01

The activities of the ERDA Interlaboratory Working Group for Data Exchange (IWGDE) during fiscal year 1976 are discussed. Created in response to an evident need for increased sharing of resources among ERDA installations, IWGDE was supported in FY 1976 through funds allocated to the Energy Analysis and Assessment programs of seven multipurpose ERDA national laboratories. Principal accomplishments include the interlaboratory exchange of socio-economic, environmental, demographic, and energy-related data bases, liaison development through interlaboratory meetings, creation of a national index of energy-related models and data bases, and definition and partial implementation of a computer-independent standard for exchange of data via magnetic tape. ERA

N77-22999# Weapons Research Establishment, Salisbury (Australia).
ANNUAL REPORT 1975 - 1976
1976 78 p
(PB-261326/3) Avail: NTIS HC A05/MF A01 CSCL 05B

Items mentioned in this report include: research and developmentt activities; advanced technology and engineering techniques; trials activity; consultation and services. The 250th Skylark upper atmosphere research rocket fired in Australia was launched from the Woomera Range in May 1976. The Civil Works Program of site preparation for the JINDALEE long range experimental was completed and a W.R.E. team took up residence at Alice Springs. The radar is designed to detect aircraft at long range below the curve of the earth's surface. The installation of the IBM 370/168 computer was completed and most of the workload transferred from the old 7090 to the new computer. A new microwave anechoic chamber constructed during 1975 began service in February 1976. GRA

N77-23000# Mitre Corp., McLean, Va. METREK Div.
SCIENTIFIC AND TECHNICAL INFORMATION: OPTIONS FOR NATIONAL ACTION
Bruce G. Whalen and Charles C. Joyce, Jr. Nov. 1976 74 p refs
(Contract NSF-76-SP-1002)
(PB-261863/5; M76-82) Avail: NTIS HC A04/MF A01 CSCL 05B

The National Science and Technology Policy, Organization and Priorities Act of 1976 (P.L. 94-282) was analyzed to determine major issues related to scientific and technical communication. Past reviews and studies were used as the basis for the analysis. Options for action were developed to provide specific approaches for the Office of Science and Technology Policy. GRA

N77-23001# National Federation of Abstracting and Indexing Services, Philadelphia, Pa.
CONFERENCE REPORT TO THE NATIONAL SCIENCE FOUNDATION ON THE NFAIS/ASIDIC MEETING ON BIBLIOGRAPHIC CONTROL Final Report
Toni Carbo Bearman 16 Sep. 1976 7 p Conf. held at Washington, D. C., 14-16 Jul. 1976
(Grant NSF DS176-15530)
(PB-261522/7) Avail: NTIS HC A02/MF A01 CSCL 05B

Data elements and data element content for search and display were discussed at a conference held in preparation for an international meeting with representatives from the European Association of Scientific Information Dissemination Centers (EUSIDIC) and the International Council of Scientific Unions Abstracting Board (ICSU AB) on bibliographic data bases. GRA

N77-23002# Mitre Corp., Bedford, Mass.
SECURE MULTILEVEL DATA BASE SYSTEM: DEMONSTRATION SCENARIOS, VOLUME 2, REVISION 1
J. L. Mack and B. N. Wagner Oct. 1976 50 p Revised
(Contract F19628-76-C-0001)
(AD-A032956; MTR-3160-Vol-2-Rev-1; ESD-TR-76-158-Vol-2-Rev-1) Avail: NTIS HC A03/MF A01 CSCL 05/2

The operation of a multilevel secure file management system using security kernel technology has been demonstrated under MITRE Project 7070. This volume of the project's final report describes three application scenarios used for demonstration of the system, and assesses their value and limitations.
Author (GRA)

N77-23003# Pennsylvania Univ., Philadelphia. Dept. of Decision Sciences Management.
DECISION ENVIRONMENT: A PROPOSED PHYSICAL INSTALLATION Interim Report
Thomas H. Johnson Sep. 1976 23 p
(Contract N00014-75-C-0440)
(AD-A033520; Rept-76-09-10) Avail: NTIS HC A02/MF A01 CSCL 05/10

The Decision Aiding Information Systems Project (DAISY), developed at the Decision Sciences Department of the Wharton School and sponsored by the Office of Naval Research, is constructing an environment to train managers to make tactical decisions more effectively and efficiently. The laboratory space will be used by several different types of decision makers, from individuals to classroom groups. It is intended for operational use assisting in the actual performance of decision making tasks, for educational use to instruct students and professionals in decision aiding methodology, and in research for extending the decision makers capabilities. The Decision Environment will be located in room E13 of Dietrich Hall and will be staffed by graduate researchers and teaching personnel. Author (GRA)

N77-23004# Defence Scientific Information Service, Ottawa (Ontario). Information Selection and Analysis Section.
DEFENCE SCIENTIFIC INFORMATION: THE USER-PROVIDER INTERFACE
D. A. Ross Sep. 1976 28 p refs
(AD-A031705; DSIS-TM-2/76(DSIR)) Avail: NTIS HC A03/MF A01 CSCL 05/9

This paper discusses the role and functions of the Information Scientist, a prime provider of scientific and technical information (STI), in the Department of National Defense. The functions described are: (a) The interface between the Information Scientist and the user; (b) the handling of incoming documents; (c) retrospective searching; (d) current awareness of SDI services; (e) the validation of requests for documents; and (f) the distribution of documents. Procedures and channels for ordering documents from DSIS are also given. GRA

N77-23005# Harry Diamond Labs., Adelphi, Md.
USING THE DATA BANK IN TACTICAL SYSTEM HARDENING AND VULNERABILITY ASSESSMENTS
Paul A. Trimmer Dec. 1976 34 p refs
(DA Proj. 1W1-62118-AH-75)
(AD-A032653; HDL-TM-76-23) Avail: NTIS HC A03/MF A01 CSCL 09/1

The data bank can be a useful tool for tactical system nuclear hardening and vulnerability assessments. This report is intended to assist the program manager in determining the extent that data banks can be used in solving his nuclear hardening or assessment problem. For programs budgeted under $250,000, a data bank can be cost effective. The results are as reliable as those obtained in a testing program, and the time saved can be considerable. The data bank and test results are compared to analytical methods of obtaining data. The analytical method gave good results for the device types investigated. GRA

N77-23006# Naval Undersea Center, San Diego, Calif.
THE BUREAU OF NAVAL PERSONNEL'S MICROFICHE IMAGE TRANSMISSION SYSTEM: A STATE-OF-THE-ART MICROFACSIMILE SYSTEM Research and Development Report, 1 Jan. - 1 Dec. 1976
Don Endicott, DN Solarek, and Ken Drake Dec. 1976 159 p refs
(AD-A033198; NUC-TP-529) Avail: NTIS HC A08/MF A01 CSCL 17/2

The Naval Undersea Center (NUC) has conducted a study for the Bureau of Naval Personnel (BUPERS) to analyze the options open in the design and development of Microfiche Image Transmission System (MITS) that could distribute Navy personnel records from BUPERS central files in Washington, D.C., to remote sites. Based upon an extensive examination of BUPERS present Microform Personnel Records System (MPRS), the study presents a preliminary design for a prototype MITS. MITS could accommodate 300 requests per day with an average response time of 48 hours. Salient design features include laser-beam spinning-mirror scanners and recorders for use at the central site and remote stations; a wide-band satellite transmission link; and use of dry-processed silver-halide output film employing a newly developed fiche format. MITS offers the fastest and most reliable means of disseminating BUPERS records. However, it is not currently competitive economically with Air Freight or the U.S. Postal Service, although technological advances will reduce its costs below those of air or postal service within 10-15 years. For the present, it is recommended that BUPERS rely upon certified mail for its normal transmission requirements. Additionally, it should implement an inexpensive, low-volume, low-speed microfacsimile transmission system for priority service between Washington, D. C., and major Navy centers. This approach will enable BUPERS to meet its near-future needs while monitoring technology trends for evidence that a more sophisticated system like MITS has become cost-effective. Author (GRA)

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

N77-23007*# Ultrasystems, Inc., Irvine, Calif.
EXAMINATION OF THE COSTS, BENEFITS AND ENERY CONSERVATION ASPECTS OF THE NASA AIRCRAFT FUEL CONSERVATION TECHNOLOGY PROGRAM
15 Nov. 1975 66 p refs
(Contract NASw-2859)
(NASA-CR-152683; Rept-8291-01) Avail: NTIS HC A04/MF A01 CSCL 05C

The costs and benefits of the NASA Aircraft Fuel Conservation Technology Program are discussed. Consideration is given to a present worth analysis of the planned program expenditures, an examination of the fuel savings to be obtained by the year 2005 and the worth of this fuel savings relative to the investment required, a comparison of the program funding with that planned by other Federal agencies for energy conservation, an examination of the private industry aeronautical research and technology financial posture for the period FY 76 - FY 85, and an assessment of the potential impacts on air and noise pollution. To aid in this analysis, a computerized fleet mix forecasting model was developed. This model enables the estimation of fuel consumption and present worth of fuel expenditures for selected commerical aircraft fleet mix scenarios. Author

N77-23008# Committee on Public Works and Transportation (U. S. House).
AVIATION ECONOMICS
Washington GPO 1976 600 p refs Joint hearings before Subcomm. on Investigations and Review and the Subcomm. on Aviation of the Comm. on Public Works and Transportation, 94th Congr., 2d Sess., 1-2, 4, 8, 10-11 Mar. and 27-29 Apr. 1976 (GPO-73-830) Avail: Subcomm. on Investigations and Review

Recommendations for government action to improve economic conditions in the air transportation industry are presented by officials of commercial airlines and members of the Civil Aviation Board. The impact of inflation on expenditures for fuel and replacement aircraft is discussed, as well as on return on investment. A.R.H.

N77-23009# Stanford Univ., Calif. Dept. of Statistics.
MARKOV MAINTENANCE MODELS WITH REPAIR
Yukio Hatoyama 5 Aug. 1976 84 p refs
(Contract N00014-75-C-0561; NR Proj. 042-002)
(AD-A033427; SU-TR-175) Avail: NTIS HC A05/MF A01 CSCL 12/2

In this study, discrete time finite state Markov maintenance models are investigated. In each model, a machine is assumed to be operating over time with its condition deteriorating as time goes on. The state of the machine is observed at the

beginning of a period. An operating machine can be sent to a repair shop at this time, whereas a failed machine must be repaired. When a machine is being repaired, the number of time periods that it is unavailable is usually assumed to have a geometric distribution. A repaired machine becomes available in its best state. An operating cost is charged while a machine is operating, and material and labor costs are charged when it is being repaired. The objective is to find a policy which minimizes the total expected alpha-discounted cost or the long-rung average cost. Special emphasis is being placed on finding sufficient conditions to assure that a control limit policy is optimal. The aforementioned model had only one machine in the system. Models with spare machines in the system are studied next. For these models a penalty cost is added when the system fails (only when all machines are inoperative). Author (GRA)

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N77-23010*# Denver Research Inst., Colo. Program for Transfer Research and Impact Studies.

SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY

Sep. 1976 206 p

(Contract NASw-2607)

(NASA-CR-152685; DRI-9/76) Avail: NTIS HC A10/MF A01 CSCL 05B

A benefits briefing notebook is presented for the NASA Technology Utilization Office in which 515 applications of NASA aerospace technology to other sections of the economy are described. An overview of technology transfer is given. Benefit cases are cited in 19 categories along with pertinent information, such as communication link, DRI transfer example file, and individual case number. General, organization, geographic, and field center indexes are provided. Author

N77-23011# Environmental Research Center, Cincinnati, Ohio.

POLISH/US SYMPOSIUM ON WASTEWATER TREATMENT AND SLUDGE DISPOSAL, VOLUME 2

Sep. 1976 168 p refs Conf. proc. held at Cincinnati, 10-12 Feb. 1976

(PB-261422/0; EPA-600/9-76-021-Vol-2) Avail: NTIS HC A08/MF A01 CSCL 13B

Topics discussed include both research work, notably in biodegradability and toxicity, and treatment and disposal methods for sludge and wastewater. Municipal and industrial (steel, tannery, and textile) wastewaters were among those considered. GRA

N77-23012# Brookhaven National Lab., Upton, N.Y.

SOLID WASTE AS AN ENERGY SOURCE FOR THE NORTHEAST

P. M. Meier and T. H. McCoy Jun. 1976 191 p refs

(Contract E(30-1)-16)

(BNL-50559; TID-4500) Avail: NTIS HC A09/MF A01

The potential contribution of energy recovery from municipal refuse to energy supply is assessed. A brief review of the present and likely future quantity and composition of municipal refuse and the technologies available for energy recovery is followed by a comparison of the potential contributions to energy supply of the various recovery options including direct firing in utility boilers, pyrolysis to oil or gas, and steam generation for industrial process heat or district space heating. The relationship of refuse energy recovery to market conditions for alternative energy sources is considered, which also includes an analysis of the impact of haul costs, interest rates, and delivered prices of the major fuels. ERA

N77-23013# Environmental Protection Agency, Washington, D.C. Office of Solid Waste Management Programs.

HAZARDOUS WASTE DISPOSAL DAMAGE REPORTS

Dec. 1975 20 p refs Reprint

(PB-261155/6; EPA-530/SW-151.2) Avail: NTIS HC A02/MF A01 CSCL 13B

Incidents of improper land disposal of hazardous wastes are reported. Topics covered include: dioxin poisoning caused by improper waste disposal in Missouri; contamination of groundwater beneath the Rocky Mountain Arsenal and surrounding area; and pollution of domestic wells in Texas. GRA

N77-23014# Environmental Protection Agency, Washington, D.C. Office of Solid Waste Management Programs.

HAZARDOUS WASTE DISPOSAL DAMAGE REPORTS

Jun. 1976 19 p refs

(PB-261156/4; EPA-530/SW-151.3) Avail: NTIS HC A02/MF A01 CSCL 13B

Incidents of improper land disposal of hazardous wastes are reported. Topics discussed include: petrochemical contamination of the Cohansey aquifer in New Jersey; Hexachlorobenzene contamination of cattle in Louisiana; and the effects of poisonous fumes on workers at a Maryland landfill. GRA

N77-23015# Minnesota Univ., Minneapolis. Water Resources Research Center.

PROBLEM IDENTIFICATION AND RANKING. A SELECTED REVIEW OF TECHNIQUES USED BY PUBLIC AGENCIES

Arnold Harris, ed. (Illinois Univ., Urbana-Champaign), Lachlan F. Blair (Illinois Univ., Urbana-Champaign), W. Thomas Lamm (Wisconsin Univ., Madison), Herman Felstehausen (Wisconsin Univ., Madison), T. A. Austin (Iowa State Univ. of Science and Technology), Gregory Clites (Iowa State Univ. of Science and Technology), Richard L. Gardner, and John J. Waelti Sep. 1976 106 p refs

(OWRT Proj. B-057-IA(1))

(PB-261391/7; W77-02080; Ser-1) Avail: NTIS HC A06/MF A01

Three aspects of water and related land resource problem identification and ranking procedures are investigated: (1) past approaches to problem identification and ranking in the Upper Mississippi River Basin; (2) an overview of present identification/ranking activities in eight selected agencies and governmental levels; and (3) a detailed investigation of identification/ranking procedures as developed within a single federal agency. GRA

N77-23016# Ballistic Research Labs., Aberdeen Proving Ground, Md.

BALLOON-BORNE, MASS-SPECTROMETER PACKAGE FOR STUDYING STRATOSPHERIC POSITIVE IONS AND NEUTRAL MOLECULES Final Report

George E. Keller Oct. 1976 38 p refs Revised

(DA Proj. 1T1-61102-B53A)

(AD-A032240; BRL-1941; BRL-IMR-192; BRL-IMR-324; BRL-IMR-424; BRL-IMR-442) Avail: NTIS HC A03/MF A01 CSCL 14/2

A balloon-borne, mass-spectrometer package for studying stratospheric positive ions and neutral molecules was built for the BRL by personnel of the University of Denver. The package was flown three times with limited success. Stratospheric ions were not definitely detected on any flight, but data acquired on the third flight showed that the concept of particle sampling with a very clean balloon package was sound. The package was destroyed at the end of the third flight following a free fall from 30 km. Author (GRA)

N77-23017# Mitre Corp., McLean, Va. METREK Div.
DEMAND RESPONSIVE TRANSPORTATION PLANNING GUIDELINES (1976)
Cady C. Chung and John R. Ferrantino Oct. 1976 81 p refs Revised
(Contract DOT-UT-50016)
(PB-261314/9; MTR-7360; UMTA-VA-06-0024-76-6) Avail: NTIS HC A05/MF A01 CSCL 13B

Demand Responsive Transportation (DRT) is a type of transit operation providing 'on-demand,' door-to-door service with small buses. More than forty DRT services are now operating in the U.S. These systems provide the data base for a set of relationships which can be used for planning and design of new DRT systems. In addition, the experience of active operators emphasizes a number of important steps in developing successful DRT services. GRA

N77-23018# Virginia Polytechnic Inst. and State Univ., Blacksburg. Water Resources Research Center.
DEEP WELL INJECTION OF INDUSTRIAL WASTES: GOVERNMENT CONTROLS AND LEGAL CONSTRAINTS
William R. Walker and William E. Cox 1976 171 p refs
(Grants NSF GI-34815; NSF GI-43675)
(PB-262184/5; NSF/RA-760316) Avail: NTIS HC A08/MF A01 CSCL 13B

The legal and institutional framework within which liquid wastes may be injected into subsurface geologic formations by means of wells is described. Until 1970, control of injection was a state responsibility; a federal program now regulates the process which is a form of long term isolation and storage, rather than waste treatment. GRA

N77-23019# Rutgers - The State Univ., New Brunswick, N. J. Water Resources Research Inst.
HYDRODYNAMICS-DISPERSION STUDIES IN STORM SEWERS Completion Report
A. M. Oguntuase (Lagos Univ.) and E. L. Bourodimos Sep. 1976 255 p refs Sponsored by Dept. of Interior
(PB-261990/6; W77-02827; OWRT-A-032-NJ(1)) Avail: NTIS HC A12/MF A01 CSCL 13B

The hydrodynamics of diffusion-dispersion processes in partially-full pipe flows descriptive of sewer flows were simulated. Equations of motion and species balance-mass transport were derived with boundary conditions applicable to free surface flows in circular pipes. Turbulent flow momentum equation was solved by a modified successive approximation numerical technique for steady flow conditions to obtain the velocity profiles, through which turbulent diffusion coefficients were estimated. Species mass transport equations were solved numerically in the three-dimensional cases of longitudinal convection with lateral and vertical diffusion. GRA

N77-23020# Transportation Systems Center, Cambridge, Mass.
PERFORMANCE ANALYSES OF INTERCITY GROUND PASSENGER TRANSPORTATION SYSTEMS Final Report, Jul. 1974 - Jun. 1975
John S. Hitz Apr. 1976 192 p refs Sponsored by Federal Railroad Admin.
(PB-261950/0; DOT-TSC-FRA-75-25; FRA/ORD-76-248) Avail: NTIS HC A09/MF A01 CSCL 13B

Analytical techniques were developed to provide a capability of evaluating new passenger train systems, and to provide information for formulating development policies for new systems. Investigations evaluated the physical performance (average velocity, system capacity, mode split) of train systems with various design characteristics operating in a range of application conditions. The analyses cover design cruise speed, acceleration and braking rates, train length, seat density and lateral acceleration limits. Application characteristics considered include station spacing, dwell time, curve length, spacing and speed, switch concepts and train control strategies. GRA

N77-23021# Mitre Corp., McLean, Va.
ENVIRONMENTAL ASSESSMENT SAMPLING AND ANALYTICAL STRATEGY PROGRAM Final Report, Nov. 1975 - Jan. 1976
J. Vlahakis and H. Abelson May 1976 64 p
(Contract EPA-68-02-1859)
(PB-261259/6; EPA-600/2-76-093a) Avail: NTIS HC A04/MF A01 CSCL 13B

A costing methodology for environmental assessment was generated for industrial processes at various phases of development to provide a framework for determining industry, process, and stream priorities on the basis of a staged sampling and analysis technique. A screening phase characterizes the pollutant potential of influent and effluent streams of a process. Sampling and analysis provide for a quantitative representation of potentially hazardous substances in those streams identified for further investigation by the screening process. The procedure provides a mechanism for recommending assessment program implementation costs as well as for estimating costs for budgetary planning purposes. GRA

N77-23022# Illinois Univ., Urbana-Champaign. Water Resources Center.
MATHEMATICAL MODELS FOR USE IN PLANNING REGIONAL WATER RESOURCES AND ENERGY SYSTEMS
E. Downey Brill, Jr., S. Giray Velioglu, and Robert W. Fuessle Nov. 1976 96 p refs
(Contract DI-14-31-0001-4174)
(PB-261364/4; UILU-WRC-76-0116; W77-02079; OWRT-B-092-ILL(1)) Avail: NTIS HC A05/MF A01 CSCL 13B

Complex public sector problems such as: (1) the extent and development of coal conversion capacity, (2) interbasin transfer of water, (3) cooling technologies for large energy facilities, (4) diversion of Lake Michigan water, and (5) allowable withdrawal and consumptive uses of river water, all arise from the interlocking nature of the water resources-energy system. Mathematical models are presented for use in planning a regional allocation of water for energy facilities as well as for other water uses. These models include components for the interrelated water and energy subsystems. The use of these models in conjunction with other existing models in order to provide a better picture of the overall system is discussed. GRA

N77-23023# Texas Technological Univ., Lubbock. Water Resources Center.
RECREATIONAL REUSE OF MUNCIPAL WASTEWATER, PHASE 2 Interim Report
Marcia Headstream, Robert M. Sweazy, Dan M. Wells, and Russell C. Baskett Apr. 1976 93 p refs
(Contract DI-14-31-0001-5205)
(PB-261256/2; WRC-76-2; W77-01824; OWRT-C-6053(5205)(1)) Avail: NTIS HC A05/MF A01 CSCL 13B

A water reuse plan for Lubbock, Texas is discussed. A series of recreation lakes being built in Yellowhouse Canyon, north and east of the city, will be fed with reclaimed percolated effluent. A model of the Canyon Lakes Project consisting of nine common-wall concrete ponds was constructed. The model system provided an excellent opportunity for ascertaining the suitability of reclaimed percolated municipal wastewater for recreational purposes, as well as an opportunity for more clearly defining the role of phosphorus in an aquatic environment. Studies were conducted relative to water quality, algal growth and control, suitability of the water for fish life and recreational contact, critical phosphorus levels, and the factors affecting the availability of phosphorus for algal growth. GRA

N77-23024# Clemson Univ., S.C.
RESEARCH NEEDS FOR AUTOMATION OF WASTEWATER TREATMENT SYSTEMS Final Report, Apr. - Dec. 1974
H. O. Buhr, J. F. Andrews, and T. M. Keinath Jan. 1977 134 p refs Workshop held at Clemson, S. C., 23-25 Sep. 1974
(Grant EPA-R-803214)
(PB-262816/2) Avail: NTIS HC A07/MF A01 CSCL 13B

Priorities for research needed to automate wastewater treatment plants were defined. The effect of automation on the design and operation of wastewater recycle systems is addressed. A need for an information clearinghouse and international exchange of data is indicated, and a philosophy of wastewater renovation as opposed to processing wastewater to the minimum quality requirements is projected. GRA

N77-23025# District of Columbia Dept. of Environmental Services, Washington, D.C. EPA-DC Pilot Plant
CONVENTIONAL TERTIARY TREATMENT Final Report
Thomas P. OFarrell and Dolloff F. Bishop (Municipal Environmental Research Lab., Cincinnati) Nov. 1976 43 p refs
(Contract DI-14-12-818)
(PB-262522/6; EPA-600/2-76-251) Avail: NTIS HC A03/MF A01 CSCL 13B

Tertiary treatment on effluent from a step aeration activated sludge system included lime clarification, air stripping of ammonia, dual media filtration, neutralization, and activated carbon adsorption. Residual BOD and phosphorus (as P) concentrations of 1.4 mg/l and 0.09 mg/l, respectively were obtained. With fresh carbon, the TOC was less than 3 mg/l after treatment by carbon adsorption. Single-stage operation with sodium carbonate addition and with a good quality secondary effluent as feed produced an average phosphorus residual of 0.53 mg/l as P after clarification. Following dual medial filtration, the phosphorus residual as P was reduced to 0.10 mg/l. GRA

N77-23026# California Univ., Davis. Water Resources Center.
MUNICIPAL WASTEWATER RECYCLING: A STRATEGY FOR MEETING THE ZERO DISCHARGE GOAL OF PL 92-500
Albert Herson (California Univ., Los Angeles) Feb. 1976 139 p refs
(PB-261912/0; UCAL-WRC-W-503; W77-02620) Avail: NTIS HC A07/MF A01 CSCL 13B

The shortage of water for irrigation, the development of efficient technology for removing pollutants from municipal effluents, and concern for the environment in general promote increased interest in reusing municipal waste water. The relationship between the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) and the implementation of waste water reuse projects is reviewed. GRA

N77-23027# California Univ., Davis. Water Resources Center.
OPTIMIZATION OF WATER RESOURCE SYSTEMS INCORPORATING EARTHQUAKE RISK Completion Report
John A. Dracup (California Univ., Los Angeles), C. Martin Duke (California Univ., Los Angeles), and Stephen E. Jacobsen (California Univ., Los Angeles) Sep. 1976 49 p refs Sponsored in part by OWRT
(PB-261985/6; UCAL-WRC-W-339; W77-02831; OWRT-B-107-CAL(3); OWRT-B-122-CAL(2); OWRT-B-144-CAL(4); OWRT-B-159-CAL(3); Rept-36) Avail: NTIS HC A03/MF A01 CSCL 13B

Computational methodology for the optimal network synthesis of a water distribution system in a region of seismic activity is presented. A mathematical programming model was developed whose optimal solution indicates which links of the network are to be constructed, the optimal flow size of each constructed link, and the seismic intensity level each constructed link should be designed to withstand. GRA

N77-23028# Maine Univ., Orono. Land and Water Resources Inst.
A STUDY OF THE PHYSICOCHEMICAL PARAMETERS AFFECTING THE REMOVAL OF COLLOIDAL PARTICLES FROM WATER BY POROUS MEDIA
Mriganka M. Ghosh Apr. 1976 37 p refs Sponsored by the US Office of Water Research and Technology
(PB-261392/5; W77-02086; OWRT-A-023-ME(2)) Avail: NTIS HC A03/MF A01 CSCL 13B

A conceptual model was developed for the depth filtration of water and wastewater using granular beds considering the effect of gravity, interception, hydrodynamic forces, London attraction, and Brownian diffusion for systems with negligible double layer forces. The ultimate capture of particles in a packed bed is determined not only by the transport mechanisms but also by the short-range surface forces which may play a dominant role in their attachment to media grains. The experimental data obtained for the filtration of latex monodispersions and secondary effluents using a polymer-coated sand bed were in good agreement with the predictive model. GRA

N77-23029# Missouri Univ., Rolla.
DEVELOPMENT OF DESIGN AND OPERATING CRITERIA FOR HANDLING ADVANCED WASTE TREATMENT PLANT SLUDGE Completion Report, Jul. 1974 - Jun. 1976
Ju-Chang Huang and K. C. Tsai Aug. 1976 38 p refs Sponsored in part by Missouri Water Resources Research Center, Rolla
(Contracts DI-14-31-0001-5025; DI-14-31-0001-6026)
(PB-261347/9; W77-02188; OWRT-A-074-MO(1)) Avail: NTIS HC A03/MF A01 CSCL 13B

A set of criteria applicable for the design and operation of an aerobic digester treating sewage lime sludge generated from advanced waste treatment plants was developed. Major parameters included are: (1) detention time; (2) degree of sludge stabilization in terms of volatile solids destruction and COD reduction; (3) sludge dewaterability; (4) fate of precipitated phosphorus; (5) destruction of coliforms; and (6) effect of temperature on the sludge stabilization. Data indicated that sewage lime sludge is treatable by biological means. GRA

N77-23030# American Society of Civil Engineers, New York. Urban Water Resources Research Council.
URBAN HYDROLOGICAL MODELING AND CATCHMENT RESEARCH IN CANADA
J. Marsalek Jun. 1976 60 p refs
(Grant NSF ENG-74-20326)
(PB-262068/0; TM-IHP-3) Avail: NTIS HC A04/MF A01 CSCL 13B

Modeling and catchment research for Canadian urban underground conduit drainage systems is reported in support of the International Hydrological Program Project study of the effects of urbanization on the hydrological regime and on water quality. Only models tested against actual field data are discussed. Applications are emphasized. GRA

N77-23031# District of Columbia Dept. of Environmental Services, Washington, D.C.
EXPERIMENTAL EVALUATION OF OXYGEN AND AIR ACTIVATED SLUDGE NITRIFICATION SYSTEMS WITH AND WITHOUT pH CONTROL Final Report, Oct. 1973 - Sep. 1974
James A. Heidman Oct. 1976 67 p refs
(Contract EPA-68-03-0349)
(PB-262197/7; EPA-600/2-76-180) Avail: NTIS HC A04/MF A01 CSCL 13B

The nitrification capabilities of two oxygen activated sludge systems receiving District of Columbia secondary effluent at a steady state flow of 190 cu m/day (50,000 gpd) were evaluated. The pH of one system was controlled to maintain a pH of 7.0 in the last reactor pass of the four-pass system. The pH of the second system was uncontrolled and reactor pH values of 5.5-6.0 were common. Also parallel air and oxygen nitrification systems both with pH control were evaluated under similar operating conditions. Parameters used to compare the systems include effluent quality, sludge settling rates, lime dosage, sludge production and nitrification kinetic rates. GRA

N77-23032# Oregon State Univ., Corvallis. Dept. of Civil Engineering.
A BIOASSAY TO ASSESS WASTEWATER TOXICITY TO AEROBIC BIOLOGICAL TREATMENT Completion Report, 1 Jul. 1975 - 30 Jun. 1976
Kenneth J. Williamson Sep. 1976 48 p refs Sponsored by Dept. of Interior
(PB-261394/1; WRRI-49; W77-02081; OWRT-A-036-ORE(1)) Avail: NTIS HC A03/MF A01 CSCL 06M

A bioassay for wastewater toxicity that could be used at sewage treatment plants was developed. Nitrobacter was used as the test organism due to the simplicity of quantifying substrate removal rates by measuring nitrite removal, a sensitivity for most toxicants greater than that of heterotrophic organisms, and a slow growth rate which enables the use of batch-fed tests. A method was developed for preserving the Nitrobacter organisms by freeze-drying. Substrate removal rates were measured for both freeze-dried and non-freeze-dried Nitrobacter in the presence of a heavy metal and an organic toxicant. GRA

N77-23033# Durham Urban Observatory, N. C.
MEASURING THE EFFECTIVENESS OF SOLID WASTE COLLECTION

Jarir S. Dajani, P. Arne Vesselind, and Gerald Hartman Mar. 1976 52 p refs *Prepared by Duke Univ., Durham, N. C.
(Contract Hud-H-2196R)
(PB-262004/5; UO-LCCM-DUR-76-001) Avail: NTIS HC A04/MF A02 CSCL 13B

A citizen's questionnaire and visual inspection were used to determine the effectiveness of street cleaning and garbage collection methods in five Durham neighborhoods. GRA

N77-23034# Dallas Dept. of Urban Planning, Tex.
URBAN DESIGN ROLE IN LOCAL GOVERNMENT
Weiming Lu Sep. 1976 75 p refs Conf. held at Dallas, 25-27 Jun. 1976
(Grant NSF GAPR-76-18500)
(PB-262370/0; NSF/RA-760215) Avail: NTIS HC A04/MF A01 CSCL 13B

The viability and increasing importance of urban environmental design in solving the problems of cities was explored. Three categories of urban design legislation, in addition to performance standards and environmental impact statements were outlined. Topics discussed include: mechanisms for implementing urban design in local government, deficiencies in urban design research today,tentative models for describing the urban design field, and alternative approaches to urban design research. GRA

N77-23035# Garcia (M. R.) and Co., Inc., New Orleans, La.
COMMERCIAL DEVELOPMENT ANALYSIS, HERITAGE SQUARE PLANNING PROJECT
Oct. 1976 80 p
(Grant EDA-08-6-01599)
(PB-261889/0; EDA-76-080) Avail: NTIS HC A05/MF A01 CSCL 13B

The feasibility of redeveloping the commercial core of the Central City Community of New Orleans was evaluated. Efforts by the Central City Community are expected to create jobs, venture capital and investment opportunities for community residents. The proposed complex can provide substantial social and economic benefits for the city as a whole. GRA

N77-23036# Williams (Charles W.), Inc., Alexandria, Va.
STRATEGY FOR THE NSF INTERGOVERNMENTAL SCIENCE AND PUBLIC TECHNOLOGY/INDUSTRIAL PROGRAM TO ENHANCE TECHNOLOGICAL INNOVATION FROM AND CAPACITY OF THE SMALL BUSINESS COMMUNITY
Charles Williams and Kendall Simmons Oct. 1976 69 p
(Grant NSF 76-SP-0907)
(PB-261951/8; NSF/RA-760306) Avail: NTIS HC A04/MF A01 CSCL 05A

The role of the National Science Foundation in meeting national objectives for the small business community is assessed. It is shown that a policy gap exists for encouraging technological innovations from this sector. GRA

N77-23037# Army Scientific Advisory Panel, Washington, D.C.
ARMY SCIENTIFIC ADVISORY PANEL SUMMER STUDY 76. VOLUME 2: AVIATION SYSTEMS SUBGROUP REPORT Final Report
Sep. 1976 42 p Conf. held at Norfolk, Va., 19-30 Jul. 1976
(AD-A031710) Avail: NTIS HC A03/MF A01 CSCL 05/1

The Army Scientific Advisory Panel (ASAP) conducted Summer Study '76 at the Armed Forces Staff College, Norfolk, VA, during the period 19-30 July 1976. The Panel examined the compatibility of the Science and Technology Objectives Guide (STOG), which delineates desired operational capabilities, and the system development plans of the various Army Laboratories to determine if the laboratory programs include the appropriate technology efforts to achieve the desired systems capabilities. The Panel made the examination through the efforts of the six Subgroups of Armament, Aviation, Electronics, Missiles, Mobility, and Soldier Support Systems, a separate report being published for each. Author (GRA)

N77-23038# Faucett (Jack) Associates, Inc., Chevy Chase, Md.
INTERREGIONAL TRANSPORTATION ANALYSIS AND CIVIL PREPAREDNESS PLANNING Final Report
Jack G. Faucett Nov. 1976 40 p refs
(Contract DAHC20-73-C-0203)
(AD-A033590) Avail: NTIS HC A03/MF A01 CSCL 15/5

The purpose of this study is an attempt to evaluate the strengths and weaknesses of alternative models for generating requirements for interregional freight transportation in context with production and consumption by region. This evaluation leads to recommendations for modifying existing models to accommodate the needs for transportation analysis, both at the national level and in regional and subregional detail. It is concluded that a feasibility type interregional input-output model has the best potential for analyzing freight transportation requirements in a recovery period as well as for analysis and projection of freight flows in general transportation planning. It is further recommended that a two-tier interregional model be constructed, the first tier dealing with regional detail with provision made for linking second-tier subregional models (as available) to the regional model. The feasibility of implementing the regional model for BEA economic regions is investigated. Author (GRA)

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N77-23039 Wisconsin Univ., Madison.
LOW RESOLUTION SPECTRA OF BRIGHT A-TYPE STARS COMPARED WITH MODEL ATMOSPHERE FLUXES Ph.D. Thesis
Robert Joseph Panek 1976 136 p
Avail: Univ. Microfilms Order No. 76-28168

In A-type stellar spectra, the cumulative effect of numerous line absorptions is observed to produce strong line blocking in the UV. These line opacities are theoretically expected to have important effects on the structure of the stellar atmosphere and hence the emergent flux at all wavelengths. Line blocked emergent fluxes from line blanketed model atmospheres are found to reproduce the general features of the observed flux distributions within the observational uncertainty for most stars. The UV line absorption features at 10 to 20 A resolution are not generally reproduced in detail however, and the models tend to be much brighter than the stars at wavelengths shorter than 1500 A. Theoretical emergent fluxes from 3600 to 4200 A are presented for 10 models in the range of effective temperature 10000 K to 8000 K and log g = 4.5 to 3.5. Dissert. Abstr.

N77-23040 Wisconsin Univ., Madison.
ABUNDANCE ANALYSES OF LATE-TYPE DWARFS Ph.D. Thesis
Lee William Hartmann 1976 125 p
Avail: Univ. Microfilms Order No. 76-28149

The possibility of detecting population differences between emission and non-emission dwarfs through abundance analyses was investigated. Red spectra with a resolution of .1 A were taken of three normal stars, 61 Cyg A, 61 Cyg B, and BD+) deg 2989, and of two emission-line stars, EQ Vir and BY Dra, with the Kitt Peak 4-m telescope. Using the differential curve of growth method, the metal abundances of all of the program stars are found to be solar within errors of .2 dex or less. Dissert. Abstr.

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

No abstracts in this category.

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance*. For space stations see *15 Launch Vehicles and Space Vehicles*.

No abstracts in this category.

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N77-23041# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

SOLAR GEOPHYSICAL DATA NUMBER 386. PART 1 (PROMPT REPORTS): DATA FOR SEPTEMBER 1976 - AUGUST 1976. EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 378 (SUPPLEMENT) FEBRUARY 1976

Hope I. Leighton Oct. 1976 117 p refs
(PB-262498/9; SGD-386-Pt-1; NOAA-76111704) Avail: NTIS HC A06/MF A01 CSCL 03B

Data presented include alert periods, daily solar indices, solar flares, solar radio waves, spacecraft observations, solar X-ray radiation, and inferred IP magnetic field polarities. It also provides data on daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices, and radio propagation indices. GRA

N77-23042# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

SOLAR-GEOPHYSICAL DATA NUMBER 386. PART 2 (COMPREHENSIVE REPORTS): DATA FOR APRIL 1976 - MARCH 1976 AND MISCELLANEA. EXPLANATION OF DATA REPORTS ISSUED AS NUMBER 378 (SUPPLEMENT) FEBRUARY 1976

Hope I. Leighton Oct. 1976 42 p refs
(PB-262499/7; SGD-386-Pt-2; NOAA-76111705) Avail: NTIS HC A03/MF A01 CSCL 03B

Data presented include solar flares, solar radio waves, energetic solar particles, abbreviated calendar record and regional flare index. GRA

N77-23043# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

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Hope I. Leighton Nov. 1976 42 p refs
(PB-263007/7; SGD-387-Pt-2; NOAA-76121303) Avail: NTIS HC A03/MF A01 CSCL 03B

Data obtained by IMP satellite include: solar flares, solar radio waves, energetic solar particles, abbreviated calendar record, regional flare index, solar radio waves spectral observations, and solar wind. GRA

N77-23044# National Geophysical and Solar-Terrestrial Data Center, Boulder, Colo.

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Hope I. Leighton Nov. 1976 121 p refs
(PB-263008/5; SGD-387-Pt-1) Avail: NTIS HC A06/MF A01 CSCL 03B

Data include: alert periods, daily solar indices, solar flares, solar radio waves, solar wind measurements, spacecraft observations, solar X-ray radiation, Coronal holes, inferred IP magnetic field polarities for October. It also provides data on daily solar activity center, sudden ionospheric disturbances, solar radio waves, cosmic rays, geomagnetic indices and radio propagation indices. GRA

93 SPACE RADIATION

Includes cosmic radiation and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N77-23045*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

IMPLICATIONS OF OUTER-ZONE RADIATIONS ON OPERATIONS IN THE GEOSTATIONARY REGION UTILIZING THE AE4 ENVIRONMENTAL MODEL

John W. Wilson and Fred M. Denn (Old Dominion Univ.) Washington May 1977 70 p refs
(NASA-TN-D-8416; L-11280) Avail: NTIS HC A04/MF A01 CSCL 03B

The radiation exposure in the region of geostationary orbits is examined in search for means of optimizing human performance. It is found that the use of slightly inclined circular orbits is one means by which exposure and spacesuit thickness requirements can be reduced. Another effective technique is to limit the extravehicular activity to those days when the short term fluctuations result in low exposure. Space-suit shielding approaching 1/2 sq cm or less may be possible by utilizing work stoppages and inclined orbits. If aluminum and other low-atomic-number materials are used to construct the habitat, then excessive wall thicknesses are required. If special bremsstrahlung shielding is used, then the habitat shield may be reduced to as low as 2 g/sq cm. Numerous tables and graphs are presented for future analysis of dose in the geostationary region. Author

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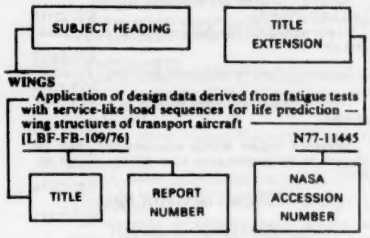

The subject heading is the key to the subject content of the document. Titles, report numbers, and accession numbers of pertinent documents are provided under each subject heading. When the title is insufficiently descriptive of the document content, a title extension has been added, separated from the title by three hyphens. The report number helps to indicate the type of document cited (e.g., NASA report, NASA translation, NASA contractor report). The NASA accession number is the number by which the document abstracts are arranged in this journal and by which the document is sold or requested. The titles, with title extensions if present, are arranged under each subject heading in ascending accession number order. The subject headings have been selected from the latest revision of the *NASA Thesaurus* (NASA SP-7050).

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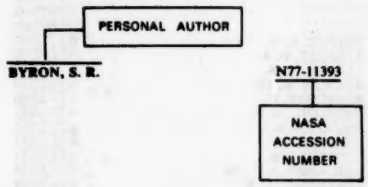

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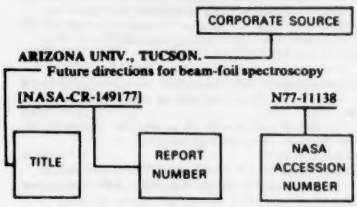

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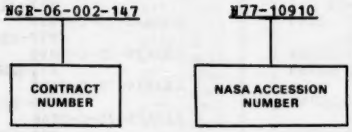

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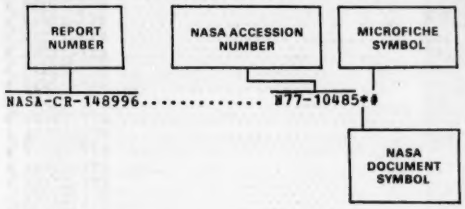

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NOAA-76122707-VOL-1 ..... N77-22695 #
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NSF/RA-760316 ..... N77-23018 #
NSF/RA-760317 ..... N77-22653 #
NSF/RA-760333 ..... N77-22670 #
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NSF/RA-760372 ..... N77-22587 #
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NSF/RA/N-74-318 ..... N77-22603 #
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NSF/RA/N-75-093B-VOL-1-APP-A ..... N77-22641 #
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PB-260718/2 ..... N77-22195 #
PB-260719/0 ..... N77-22398 #
PB-260848/7 ..... N77-22680 #
PB-260865/1 ..... N77-22208 #
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